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Subrahmanya et al.

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(54) **FLASH GAS BYPASS SYSTEMS AND METHODS FOR AN HVAC SYSTEM**

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F25B 39/00 (2006.01)
F25B 39/02 (2006.01)

(52) **U.S. Cl.**

CPC ***F25B 43/00*** (2013.01); ***F25B 39/00*** (2013.01); *F25B 39/02* (2013.01); *F25B 2400/0409* (2013.01); *F25B 2400/23* (2013.01)

(58) **Field of Classification Search**

CPC F25B 43/00; F25B 39/00; F25B 39/02; F25B 2400/0409; F25B 2400/23;

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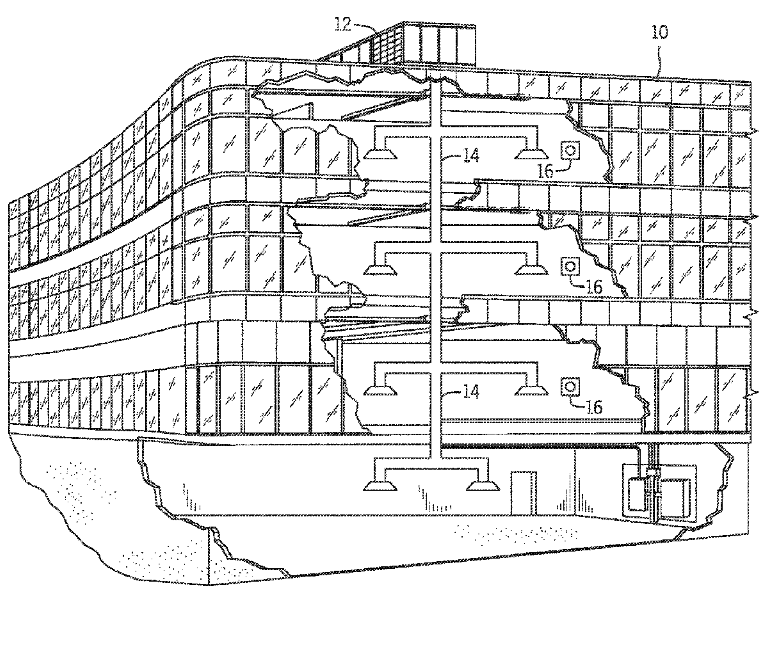
(57) **ABSTRACT**

A flash gas bypass system includes a separation assembly having an inlet configured to receive a refrigerant flow from an expansion valve. A bypass conduit is coupled to a first port of the separation assembly and configured to receive a first portion of the refrigerant flow via the first port, where the first portion of the refrigerant flow includes flash gas. A second port of the separation assembly is coupled to an outlet conduit in fluid communication with an evaporator. The outlet conduit is configured to receive the second portion of the refrigerant flow via the second port and direct the second portion of the refrigerant flow toward the evaporator, where the second portion of the refrigerant flow includes liquid refrigerant. A filter is configured to redirect droplets captured by the filter from the first portion of the refrigerant flow into the second portion of the refrigerant flow.

19 Claims, 11 Drawing Sheets



(58) **Field of Classification Search**
CPC F25B 5/02; F25B 43/003; F25B 41/20; F25B 41/42
USPC 62/527
See application file for complete search history.

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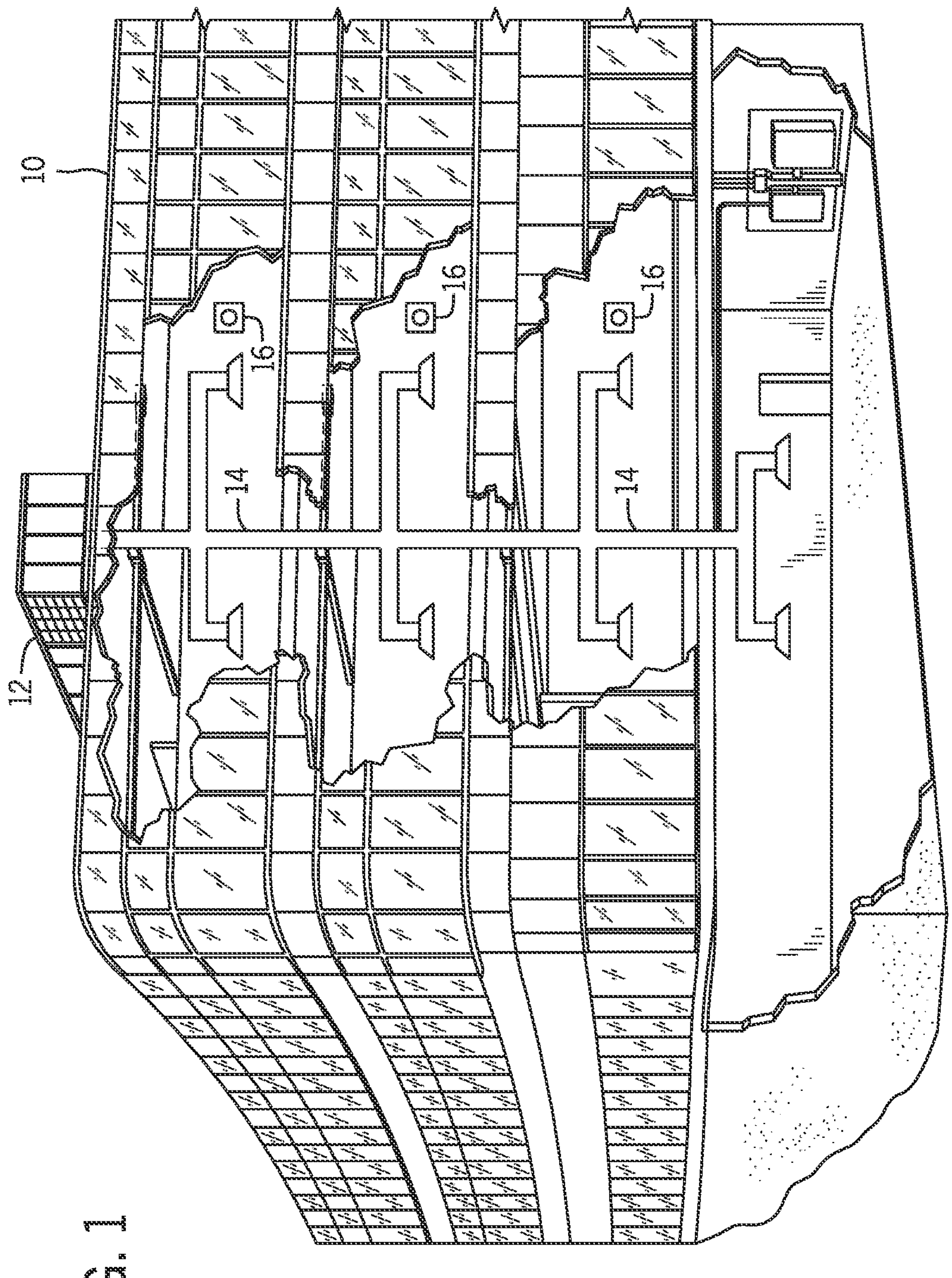


FIG. 1

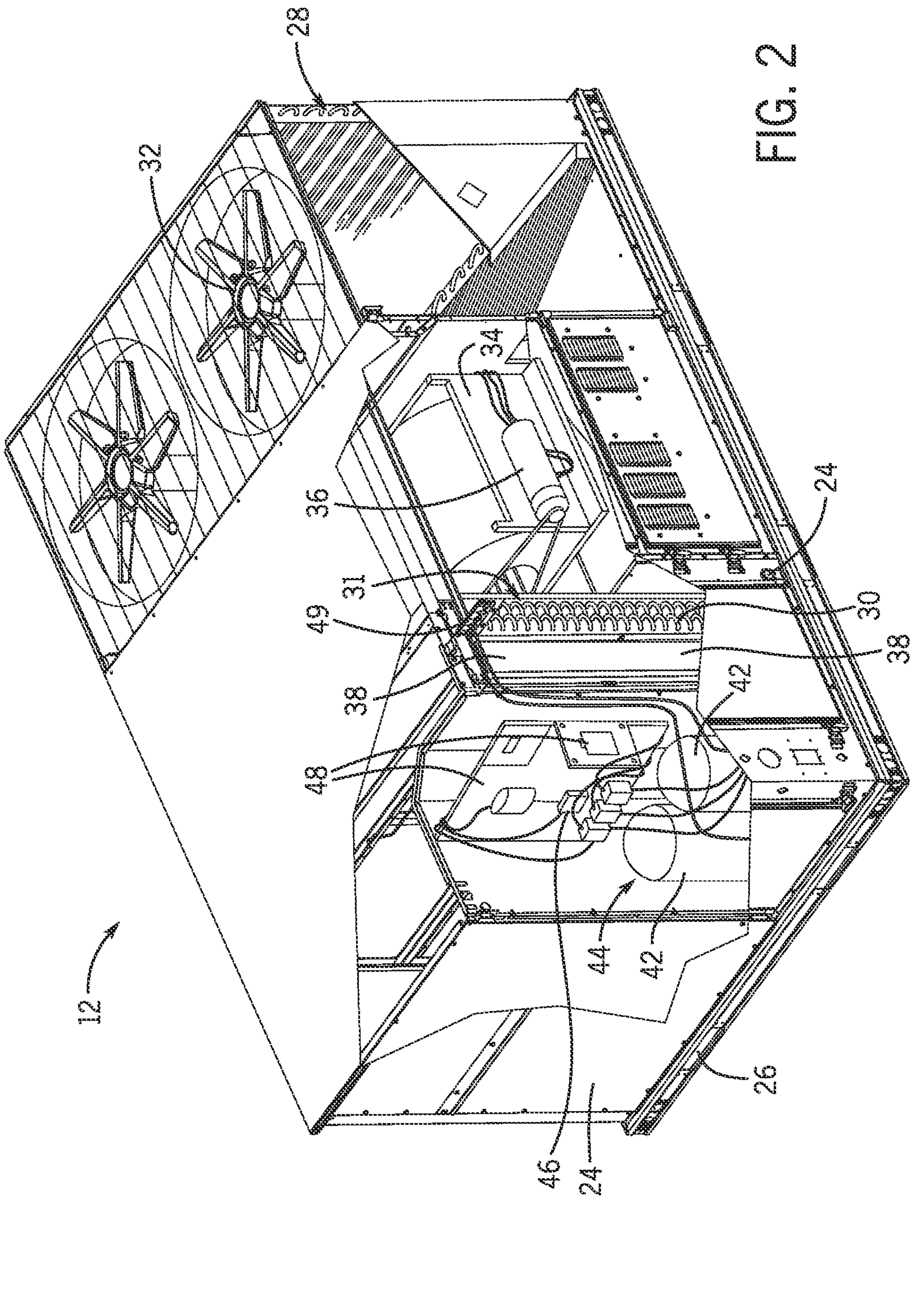


FIG. 2

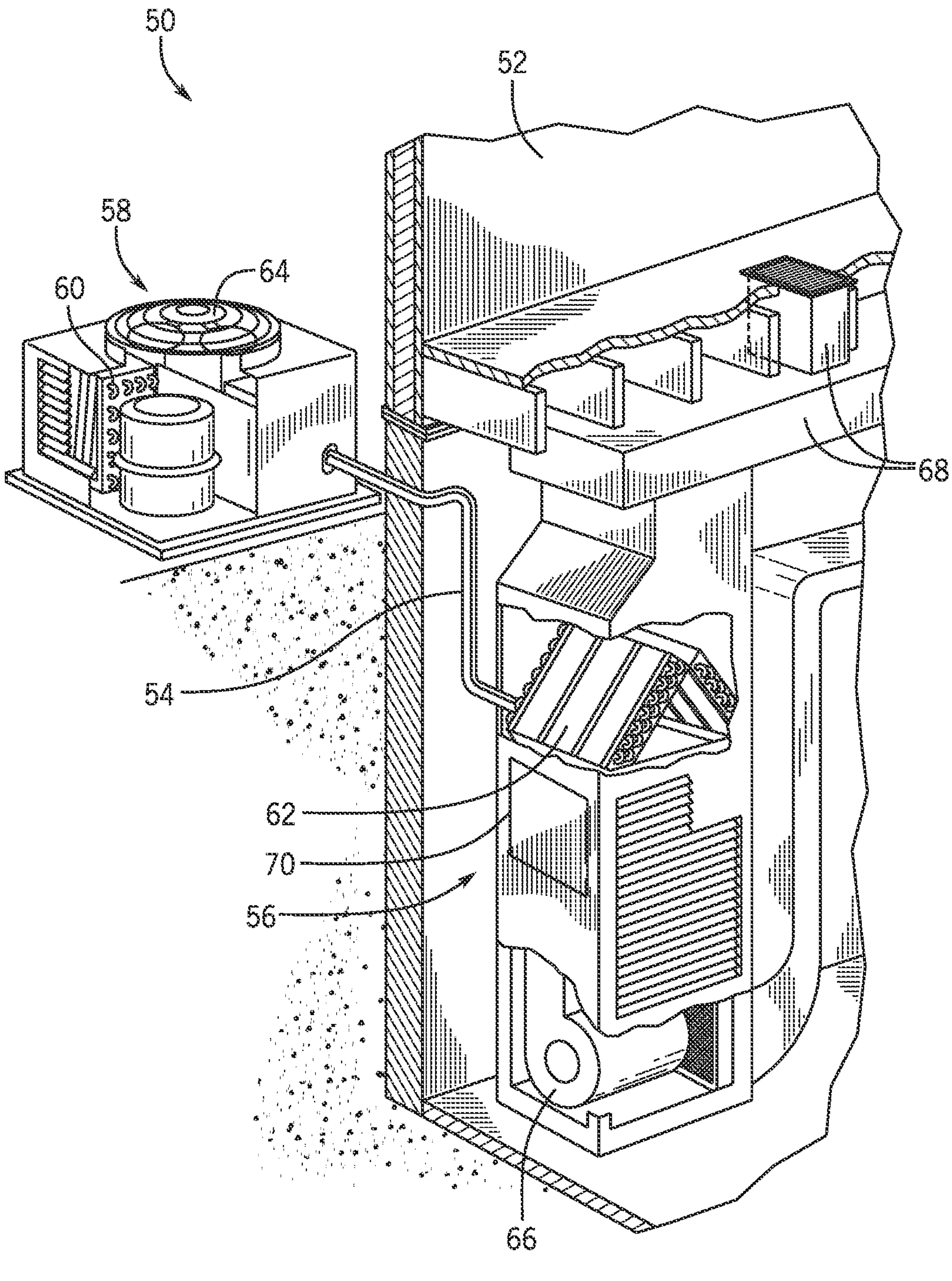
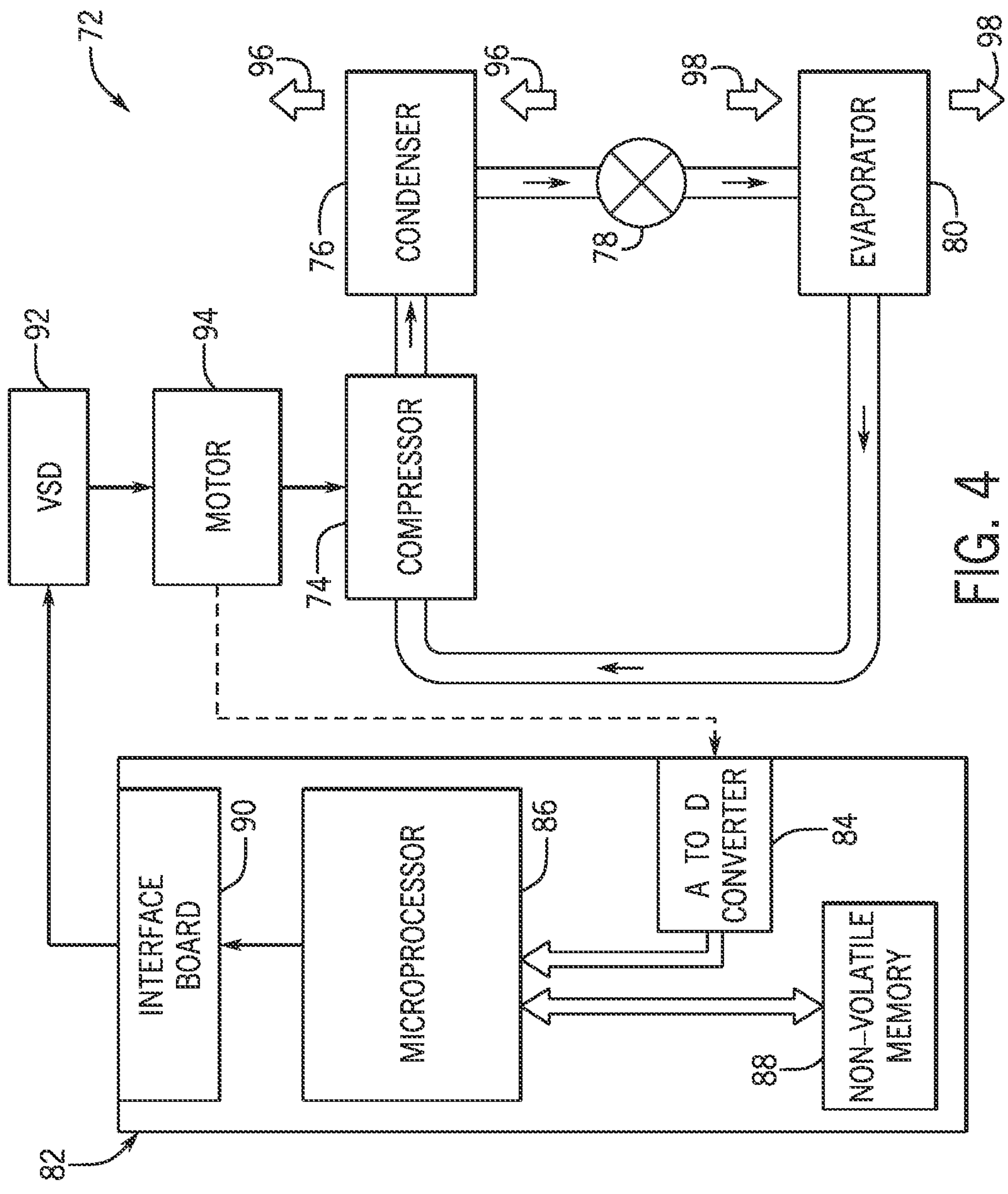


FIG. 3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INTERFACE BOARD
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MICROPROCESSOR
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A TO D CONVERTER
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NON-VOLATILE MEMORY
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FIG. 4

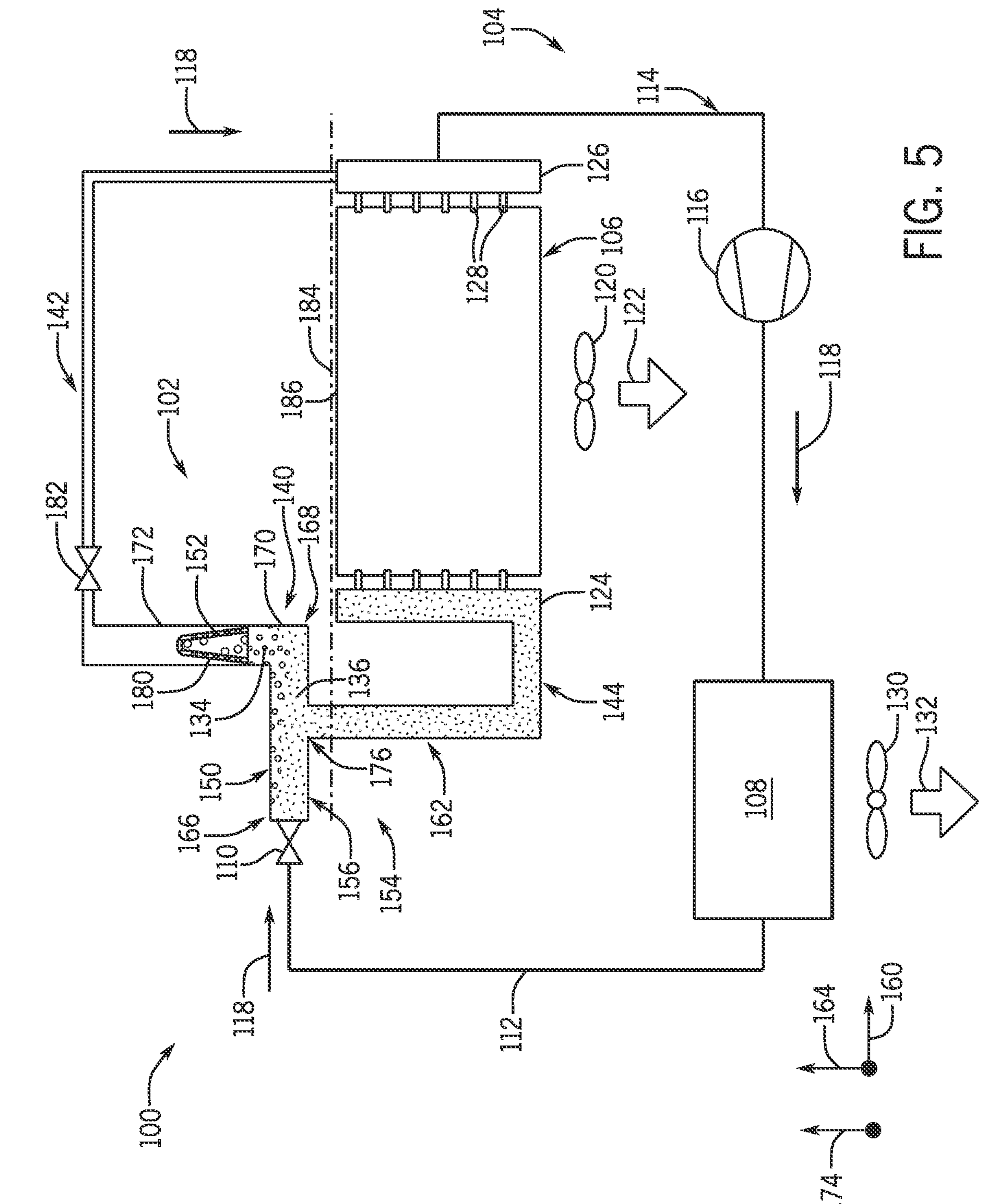
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FIG. 5

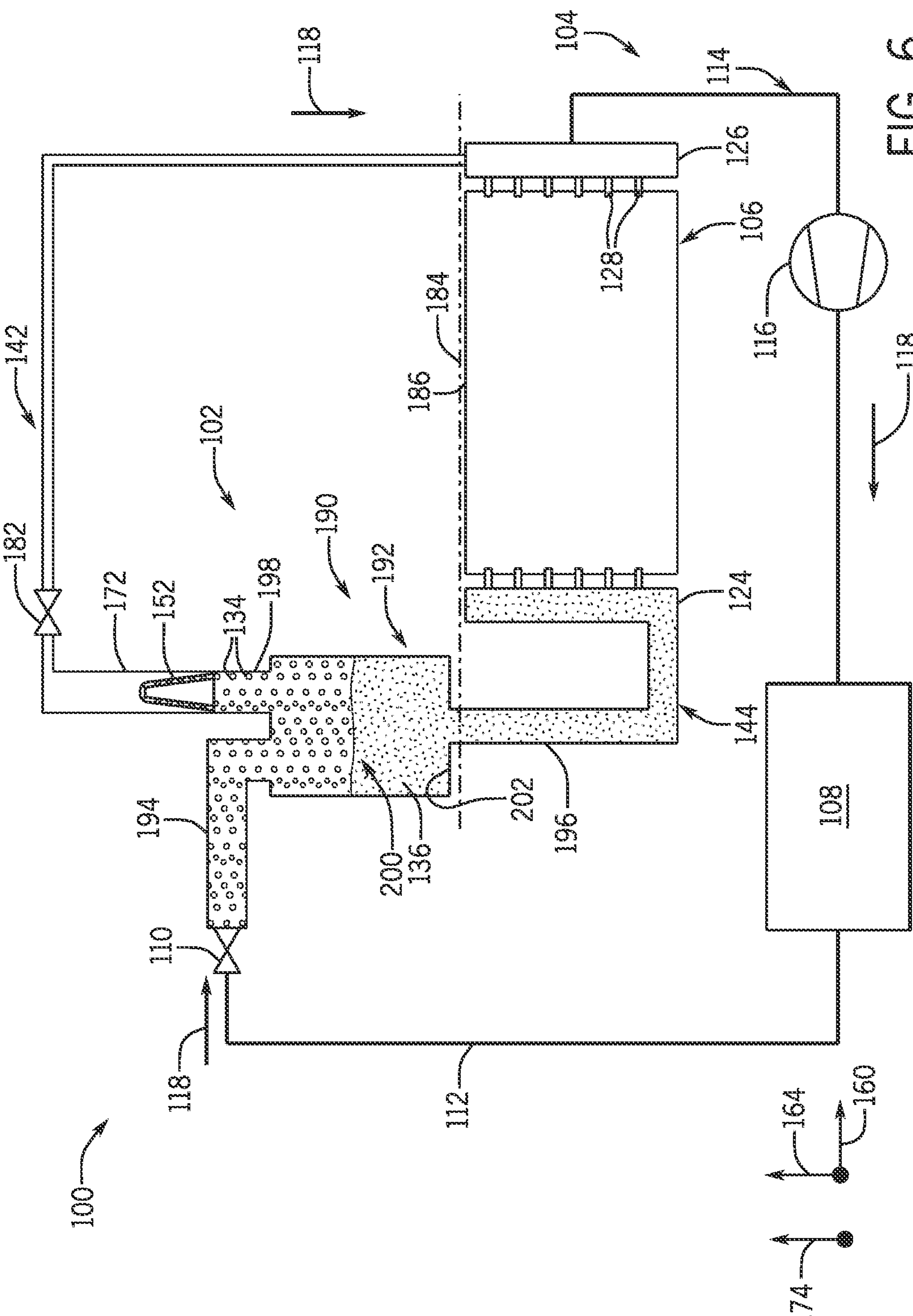
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FIG. 6

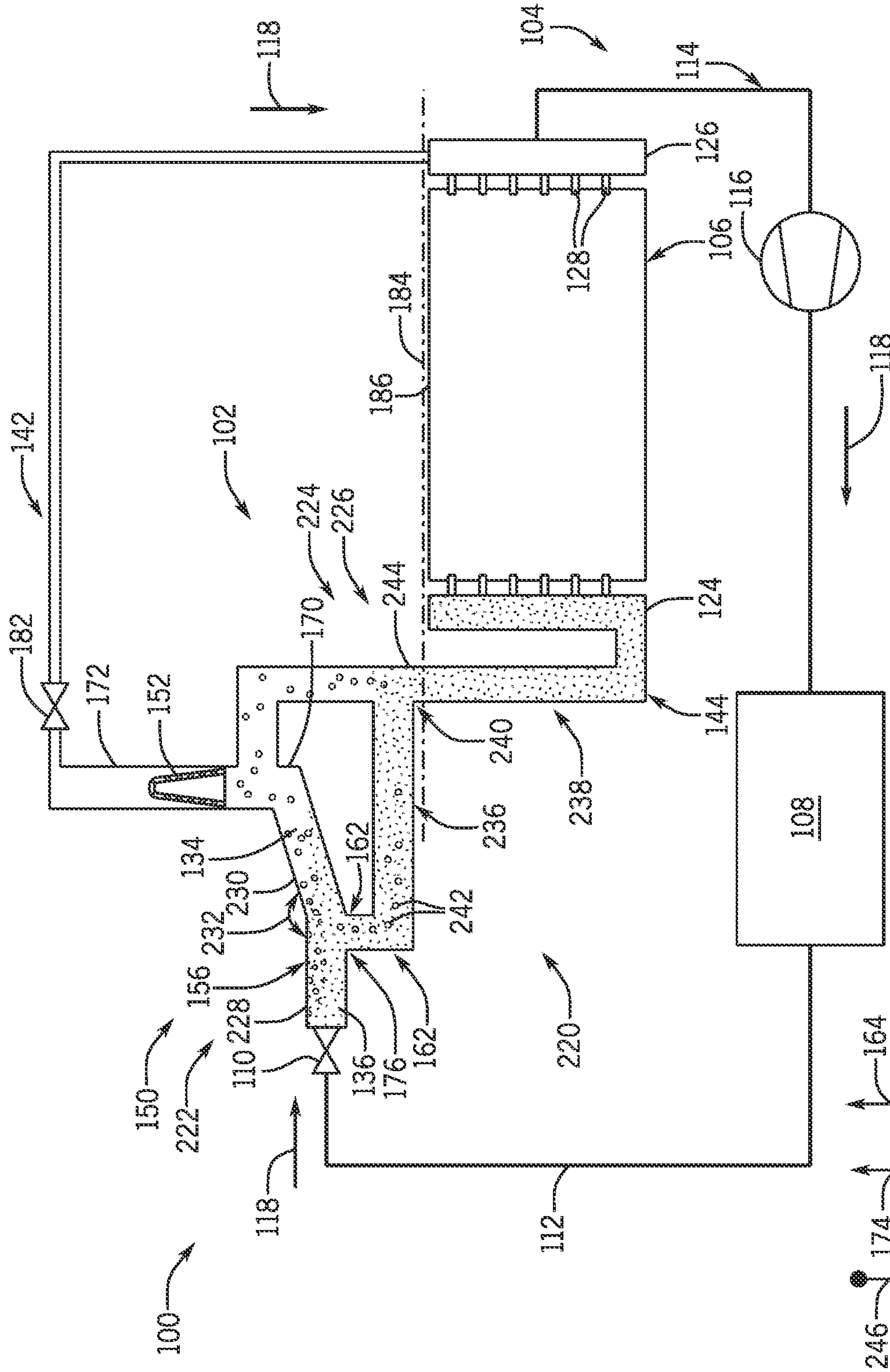
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FIG. 7

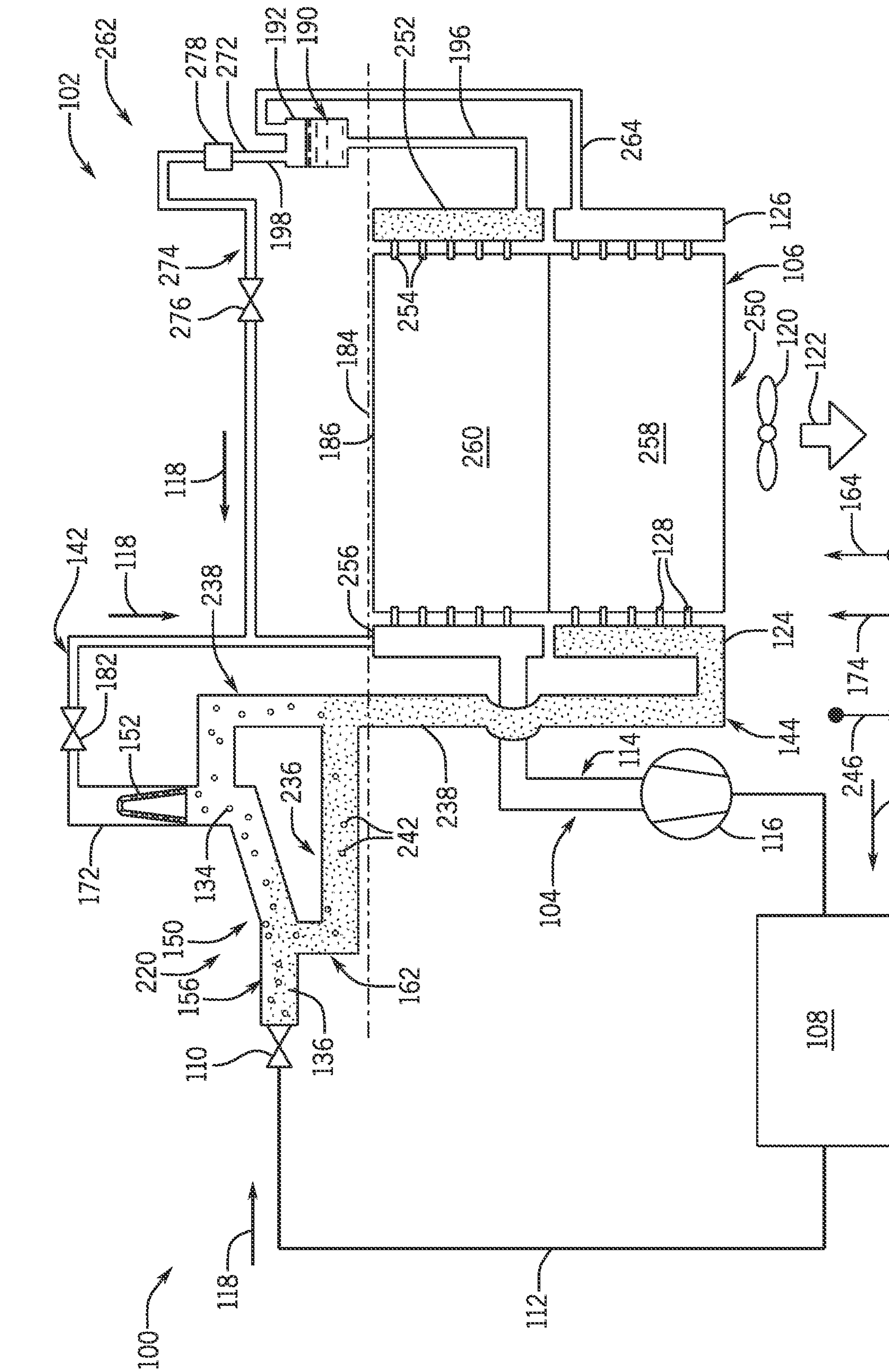
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FIG. 8

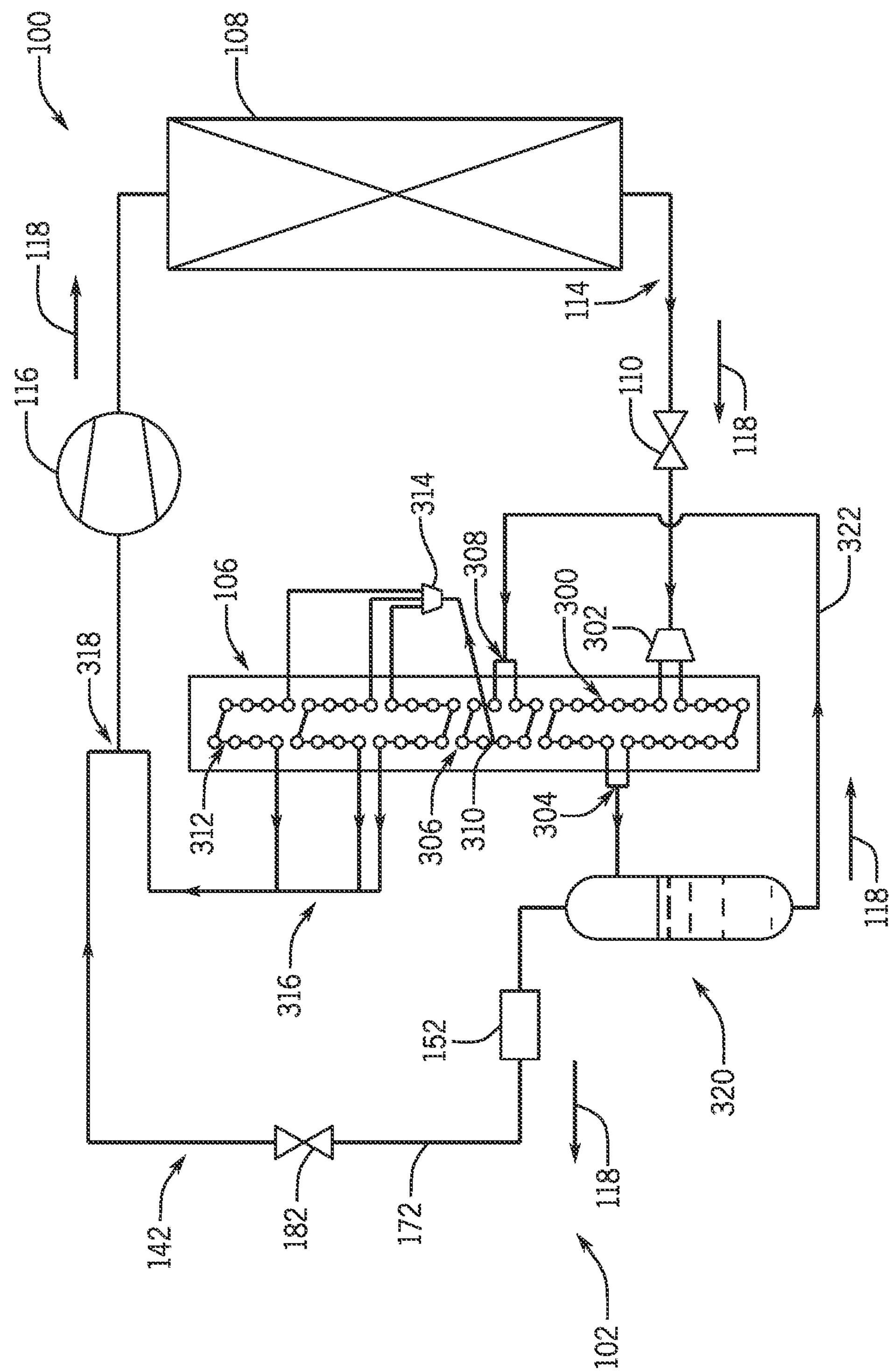
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FIG. 9

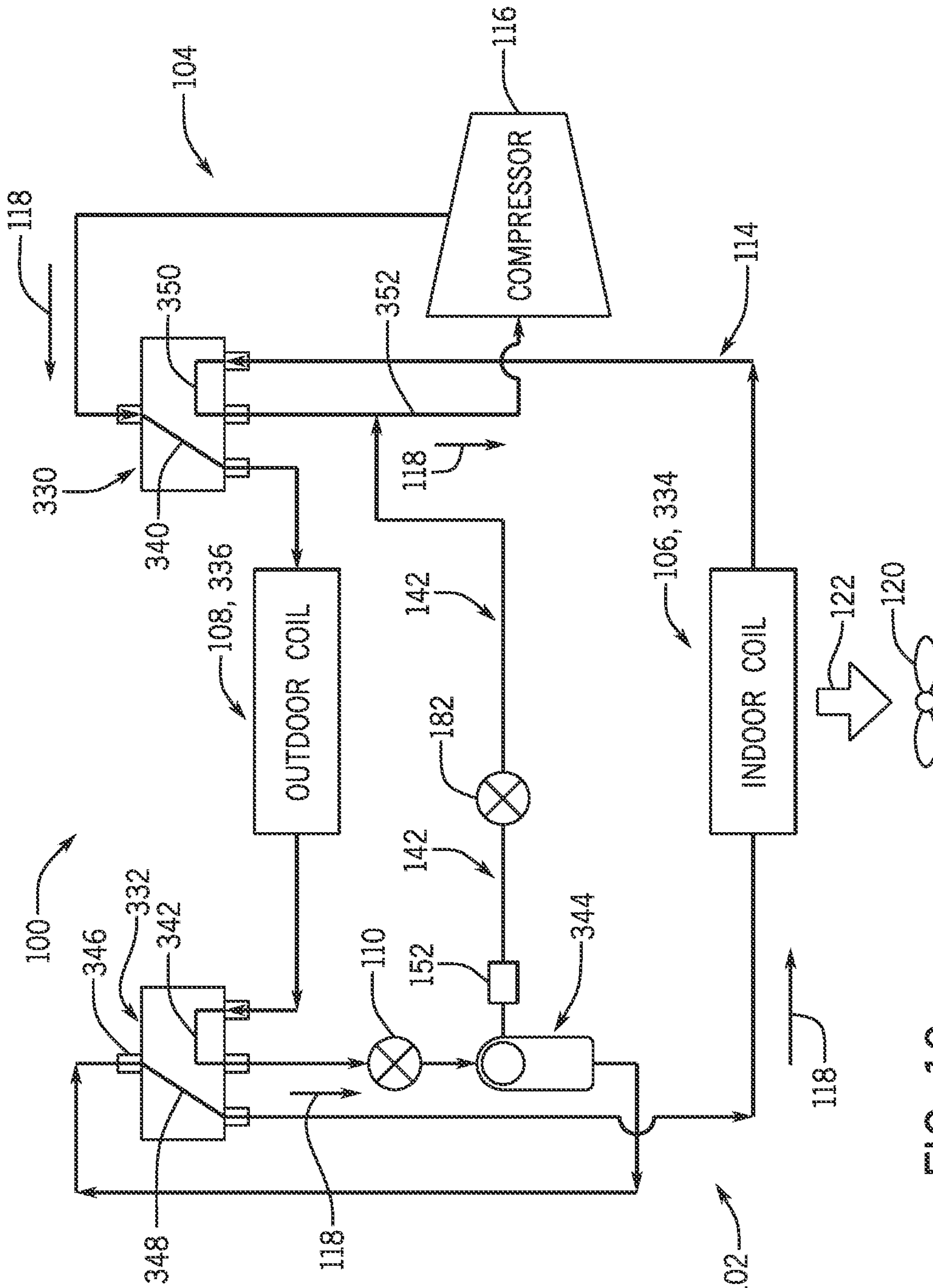
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FIG. 10

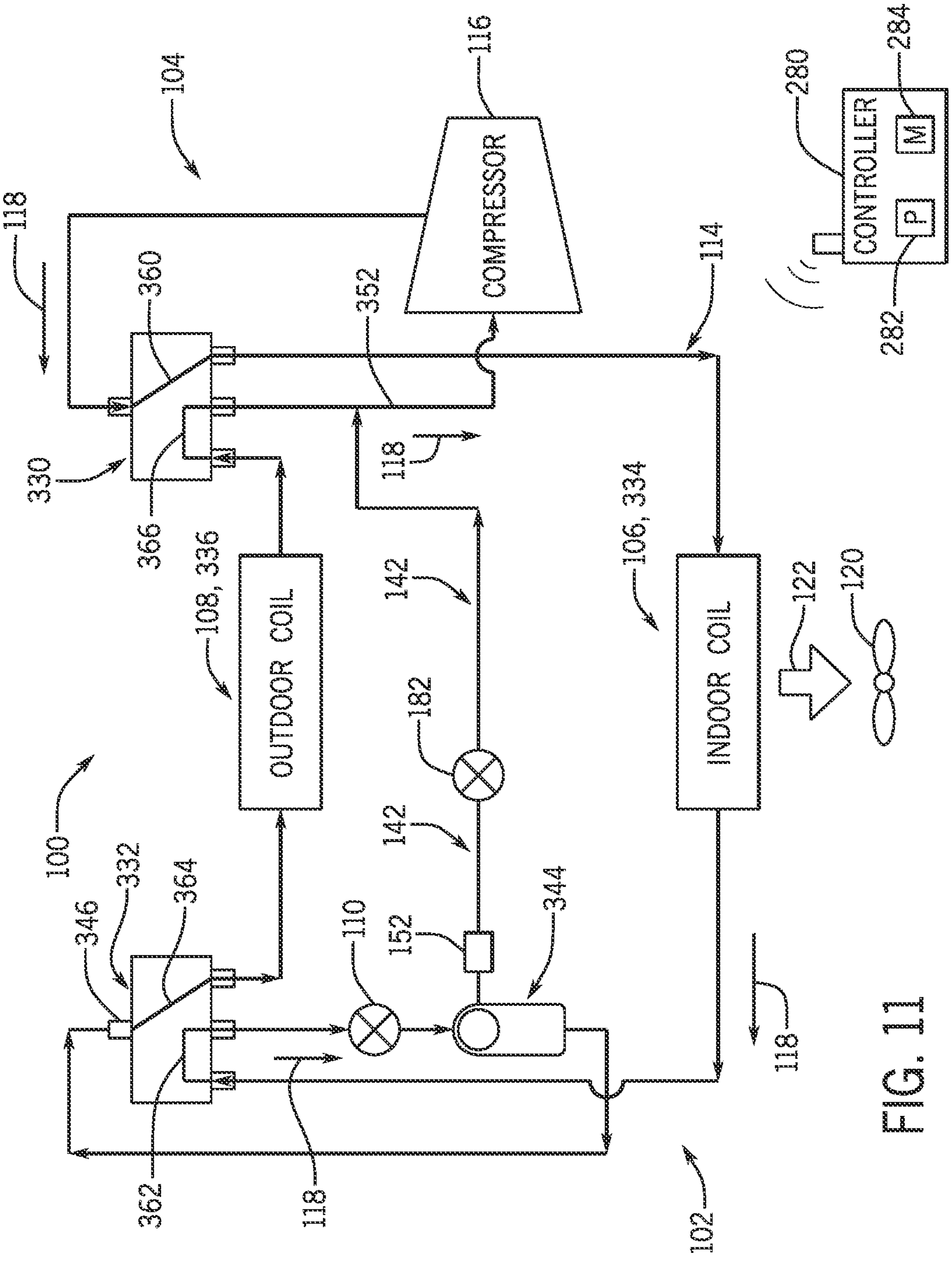
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FIG. 11

FLASH GAS BYPASS SYSTEMS AND METHODS FOR AN HVAC SYSTEM

BACKGROUND

This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, which are described below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

A heating, ventilation, and/or air conditioning (HVAC) system may be used to thermally regulate an environment, such as a space within a building, home, or other structure. The HVAC system generally includes a vapor compression system having heat exchangers, such as a condenser and an evaporator, which are fluidly coupled to one another via conduits of a refrigerant loop. A compressor may be used to circulate a refrigerant through the refrigerant loop to enable the transfer of thermal energy between components of the HVAC system (e.g., the condenser, the evaporator) and the environment. Typically, an expansion device is fluidly coupled between the condenser and the evaporator and configured to regulate expansion of refrigerant (e.g., liquid refrigerant) received from the condenser and flowing toward the evaporator. In this way, the expansion device may reduce pressure and/or flow rate of the refrigerant received from the condenser prior to directing the refrigerant to the evaporator. In some cases, expansion and pressure reduction of the refrigerant flowing across the expansion device may cause at least a portion of the refrigerant to vaporize upon discharge from the expansion device. As such, the expansion device may discharge and direct a mixture of two-phase refrigerant having a liquid component and a vaporous component (e.g., flash gas) to the evaporator. It is now recognized that directing flash gas into and through the evaporator may reduce an overall operational efficiency of the HVAC system.

SUMMARY

The present disclosure relates to a flash gas bypass system that includes a separation assembly having an inlet configured to receive a refrigerant flow from an expansion valve. A bypass conduit is coupled to a first port of the separation assembly and configured to receive a first portion of the refrigerant flow via the first port, where the first portion of the refrigerant flow includes flash gas. A second port of the separation assembly is coupled to an outlet conduit in fluid communication with an evaporator. The outlet conduit is configured to receive the second portion of the refrigerant flow via the second port and direct the second portion of the refrigerant flow toward the evaporator, where the second portion of the refrigerant flow includes liquid refrigerant. A filter is configured to redirect droplets captured by the filter from the first portion of the refrigerant flow into the second portion of the refrigerant flow.

The present disclosure also relates to a heating, ventilating, and air conditioning (HVAC) system that includes a heat exchanger of a refrigerant loop and a separation assembly fluidly coupled to the heat exchanger. The separation assembly is configured to receive a flow of two-phase refrigerant from an expansion valve, where the two-phase refrigerant includes liquid refrigerant and gaseous refrigerant. The separation assembly includes a first port coupled to a bypass conduit defining a flow path along the refrigerant loop that is independent of the heat exchanger. The separation assembly includes a filter configured to enable flow of the gaseous refrigerant into the bypass conduit and block flow of the liquid refrigerant into the bypass conduit. The separation assembly also includes a second port configured to receive the liquid refrigerant and to direct flow of the liquid refrigerant into the heat exchanger.

The present disclosure also relates to a heating, ventilating, and air conditioning (HVAC) system that includes an evaporator having one or more first tubes defining a first pass for a refrigerant flow through the evaporator and one or more second tubes defining a second pass for the refrigerant flow through the evaporator. The HVAC system also includes a separation assembly fluidly coupled between the first pass and the second pass and configured to receive the refrigerant flow from the first pass. The separation assembly includes a first port configured to fluidly couple to a bypass conduit and a filter configured to enable flow of a first portion of the refrigerant flow through the first port and to block flow of a second portion of the refrigerant flow, wherein the first portion includes flash gas. The separation assembly also includes a second port coupled to the second pass and configured to direct the second portion of the refrigerant flow into the second pass, wherein the second portion includes liquid refrigerant.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of an embodiment of a building incorporating a heating, ventilation, and/or air conditioning (HVAC) system in a commercial setting, in accordance with an aspect of the present disclosure;

FIG. **2** is a perspective view of an embodiment of a packaged HVAC unit, in accordance with an aspect of the present disclosure;

FIG. **3** is a perspective view of an embodiment of a split, residential HVAC system, in accordance with an aspect of the present disclosure;

FIG. **4** is a schematic diagram of an embodiment of a vapor compression system used in an HVAC system, in accordance with an aspect of the present disclosure;

FIG. **5** is a schematic diagram of an embodiment of a portion of an HVAC system that includes a flash gas bypass system having an offset impact junction, in accordance with an aspect of the present disclosure;

FIG. **6** is a schematic diagram of an embodiment of a portion of an HVAC system that includes a flash gas bypass system having a separation tank, in accordance with an aspect of the present disclosure;

FIG. **7** is a schematic diagram of an embodiment of a portion of an HVAC system that includes a flash gas bypass system having an offset impact junction and a T-style impact junction, in accordance with an aspect of the present disclosure;

FIG. **8** is a schematic diagram of an embodiment of a portion of an HVAC system that includes a flash gas bypass system and a multi-pass heat exchanger, in accordance with an aspect of the present disclosure;

FIG. **9** is a schematic diagram of an embodiment of a portion of an HVAC system that includes a flash gas bypass system and a round-tube plate finned (RTPF) heat exchanger, in accordance with an aspect of the present disclosure;

FIG. **10** is a schematic diagram of an embodiment of a heat pump having a flash gas bypass system, in accordance with an aspect of the present disclosure; and

FIG. **11** is a schematic diagram of an embodiment of a heat pump having a flash gas bypass system, in accordance with an aspect of the present disclosure.

DETAILED DESCRIPTION

One or more specific embodiments of the present disclosure will be described below. These described embodiments are only examples of the presently disclosed techniques. Additionally, in an effort to provide a concise description of these embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

When introducing elements of various embodiments of the present disclosure, the articles "a," "an," and "the" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Additionally, it should be understood that references to "one embodiment" or "an embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features.

As briefly discussed above, a heating, ventilation, and/or air conditioning (HVAC) system may be used to thermally regulate a space within a building, home, or other suitable structure. For example, the HVAC system may include a vapor compression system that transfers thermal energy between a working fluid, such as a refrigerant, and a fluid to be conditioned, such as air. The vapor compression system includes a condenser and an evaporator that are fluidly coupled to one another via one or more conduits of a refrigerant loop. A compressor may be used to circulate the refrigerant through the conduits and other components of the refrigerant loop (e.g., an expansion device) and, thus, enable the transfer of thermal energy between components of the refrigerant loop (e.g., between the condenser and the evaporator) and one or more thermal loads (e.g., an environmental air flow, a supply air flow).

Generally, the compressor is configured to draw a flow of substantially gaseous refrigerant from the evaporator, compress the gaseous refrigerant into a high-pressure refrigerant gas, and direct the high-pressure refrigerant gas into the condenser. The condenser is configured to facilitate condensation of the refrigerant gas, such that the refrigerant may discharge from the condenser as high-pressure liquid refrigerant. An expansion device (e.g., expansion valve) is typically disposed along the refrigerant loop between the condenser and the evaporator and configured to receive the high-pressure liquid refrigerant discharging from the condenser. The expansion device may expand (e.g., reduce a pressure of) the high-pressure liquid refrigerant received from the condenser prior to directing the refrigerant to the evaporator. In some cases, expansion of the liquid refrigerant received at the expansion device may cause at least a portion of the liquid refrigerant to vaporize and discharge from the expansion device in a gaseous state. Gaseous refrigerant that is discharged from the expansion device during operation of the HVAC system will be referred to herein as "flash gas." As such, typical expansion devices may direct a two-phase mixture of liquid refrigerant and flash gas into the evaporator, which is disposed downstream of the expansion device (e.g., with respect to a direction of refrigerant flow through the refrigerant loop). Unfortunately, directing flash gas into the evaporator alongside liquid refrigerant may decrease an overall rate of heat exchange between the refrigerant flowing through the evaporator and a fluid (e.g., air) that may be directed across the evaporator. As a result, directing flash gas into and through the evaporator may reduce an operational efficiency of the HVAC system.

Accordingly, embodiments of the present disclosure are directed to a flash gas bypass system that is configured to inhibit or substantially mitigate flow of flash gas from the expansion device into the evaporator. For example, the flash gas bypass system includes one or more separation components that are configured to receive the two-phase refrigerant mixture that may typically discharge from the expansion device during operation of the HVAC system. The separation components are configured to facilitate separation of liquid refrigerant and flash gas from the two-phase refrigerant mixture. In particular, the separation components are configured to direct or otherwise divert the liquid refrigerant discharging from the expansion device into the evaporator while directing or otherwise diverting the flash gas into a bypass line. As discussed in detail herein, the bypass line enables the flash gas received from the separation components to bypass the evaporator and flow toward the compressor without flowing through the evaporator. To this end, the flash gas bypass system ensures that substantially all flash gas that may be generated via refrigerant flow across the expansion device bypasses the evaporator and that the refrigerant received by the evaporator (e.g., from the expansion device) is in a substantially liquid state.

By reducing or substantially eliminating a gaseous component (e.g., flash gas) of the refrigerant flowing through the evaporator, the flash gas bypass system may enhance an effective rate of heat transfer between the remaining refrigerant (e.g., substantially liquid refrigerant) circulating through the evaporator and a fluid flow (e.g., an air flow) directed across the evaporator. In this way, the flash gas bypass system may enhance an overall operational efficiency of the HVAC system. For clarity, as used herein, discussion of a refrigerant in a "substantially liquid state" or "liquid refrigerant" may refer to refrigerant having a phase composition that is 94 percent, 95 percent, 96 percent, 97 percent, 98 percent or more liquid refrigerant and 6 percent, 5 percent, 4 percent, 3 percent, 2 percent or less flash gas (e.g., gaseous refrigerant). As used herein, the "phase composition" of a fluid may refer to a ratio correlating an amount of fluid that is in a liquid state or phase to an amount of the fluid that is in a gaseous (e.g., vapor) state or phase. Moreover, as used herein, "flash gas" may refer to refrigerant having a phase composition that is 94 percent, 95 percent, 96 percent, 97 percent, 98 percent or more gaseous refrigerant and 6 percent, 5 percent, 4 percent, 3 percent, 2 percent or less liquid refrigerant. These and other features will be described below with reference to the drawings.

Turning now to the drawings, FIG. **1** illustrates an embodiment of a heating, ventilation, and/or air conditioning (HVAC) system for environmental management that employs one or more HVAC units in accordance with the present disclosure. As used herein, an HVAC system includes any number of components configured to enable regulation of parameters related to climate characteristics, such as temperature, humidity, air flow, pressure, air quality, and so forth. For example, an "HVAC system" as used herein is defined as conventionally understood and as further described herein. Components or parts of an "HVAC system" may include, but are not limited to, all, some of, or individual parts such as a heat exchanger, a heater, an air flow control device, such as a fan, a sensor configured to detect a climate characteristic or operating parameter, a filter, a control device configured to regulate operation of an HVAC system component, a component configured to enable regulation of climate characteristics, or a combination thereof. An "HVAC system" is a system configured to provide such functions as heating, cooling, ventilation, dehumidification, pressurization, refrigeration, filtration, or any combination thereof. The embodiments described herein may be utilized in a variety of applications to control climate characteristics, such as residential, commercial, industrial, transportation, or other applications where climate control is desired.

In the illustrated embodiment, a building **10** is air conditioned by a system that includes an HVAC unit **12** with a flash gas bypass system in accordance with present embodiments. The building **10** may be a commercial structure or a residential structure. As shown, the HVAC unit **12** is disposed on the roof of the building **10**; however, the HVAC unit **12** may be located in other equipment rooms or areas adjacent the building **10**. The HVAC unit **12** may be a single package unit containing other equipment, such as a blower, integrated air handler, and/or auxiliary heating unit. In other embodiments, the HVAC unit **12** may be part of a split HVAC system, such as the system shown in FIG. **3**, which includes an outdoor HVAC unit **58** and an indoor HVAC unit **56**.

The HVAC unit **12** is an air cooled device that implements a refrigeration cycle to provide conditioned air to the building **10**. Specifically, the HVAC unit **12** may include one or more heat exchangers across which an air flow is passed to condition the air flow before the air flow is supplied to the building. In the illustrated embodiment, the HVAC unit **12** is a rooftop unit (RTU) that conditions a supply air stream, such as environmental air and/or a return air flow from the building **10**. After the HVAC unit **12** conditions the air, the air is supplied to the building **10** via ductwork **14** extending throughout the building **10** from the HVAC unit **12**. For example, the ductwork **14** may extend to various individual floors or other sections of the building **10**. In certain embodiments, the HVAC unit **12** may be a heat pump that provides both heating and cooling to the building with one refrigeration circuit configured to operate in different modes. In other embodiments, the HVAC unit **12** may include one or more refrigeration circuits for cooling an air stream and a furnace for heating the air stream.

A control device **16**, one type of which may be a thermostat, may be used to designate the temperature of the conditioned air. The control device **16** also may be used to control the flow of air through the ductwork **14**. For example, the control device **16** may be used to regulate operation of one or more components of the HVAC unit **12** or other components, such as dampers and fans, within the building **10** that may control flow of air through and/or from the ductwork **14**. In some embodiments, other devices may be included in the system, such as pressure and/or temperature transducers or switches that sense the temperatures and pressures of the supply air, return air, and so forth. Moreover, the control device **16** may include computer systems that are integrated with or separate from other building control or monitoring systems, and even systems that are remote from the building **10**.

FIG. **2** is a perspective view of an embodiment of the HVAC unit **12** that includes a flash gas bypass system in accordance with present embodiments. In the illustrated embodiment, the HVAC unit **12** is a single package unit that may include one or more independent refrigeration circuits and components that are tested, charged, wired, piped, and ready for installation. The HVAC unit **12** may provide a variety of heating and/or cooling functions, such as cooling only, heating only, cooling with electric heat, cooling with dehumidification, cooling with gas heat, or cooling with a heat pump. As described above, the HVAC unit **12** may directly cool and/or heat an air stream provided to the building **10** to condition a space in the building **10**.

As shown in the illustrated embodiment of FIG. **2**, a cabinet **24** encloses the HVAC unit **12** and provides structural support and protection to the internal components from environmental and other contaminants. In some embodiments, the cabinet **24** may be constructed of galvanized steel and insulated with aluminum foil faced insulation. Rails **26** may be joined to the bottom perimeter of the cabinet **24** and provide a foundation for the HVAC unit **12**. In certain embodiments, the rails **26** may provide access for a forklift and/or overhead rigging to facilitate installation and/or removal of the HVAC unit **12**. In some embodiments, the rails **26** may fit into "curbs" on the roof to enable the HVAC unit **12** to provide air to the ductwork **14** from the bottom of the HVAC unit **12** while blocking elements such as rain from leaking into the building **10**.

The HVAC unit **12** includes heat exchangers **28** and **30** in fluid communication with one or more refrigeration circuits. Tubes within the heat exchangers **28** and **30** may circulate refrigerant, such as R-410A, through the heat exchangers **28** and **30**. The tubes may be of various types, such as multichannel tubes, conventional copper or aluminum tubing, and so forth. Together, the heat exchangers **28** and **30** may implement a thermal cycle in which the refrigerant undergoes phase changes and/or temperature changes as it flows through the heat exchangers **28** and **30** to produce heated and/or cooled air. For example, the heat exchanger **28** may function as a condenser where heat is released from the refrigerant to ambient air, and the heat exchanger **30** may function as an evaporator where the refrigerant absorbs heat to cool an air stream. In other embodiments, the HVAC unit **12** may operate in a heat pump mode where the roles of the heat exchangers **28** and **30** may be reversed. That is, the heat exchanger **28** may function as an evaporator and the heat exchanger **30** may function as a condenser. In further embodiments, the HVAC unit **12** may include a furnace for heating the air stream that is supplied to the building **10**. While the illustrated embodiment of FIG. **2** shows the HVAC unit **12** having two of the heat exchangers **28** and **30**, in other embodiments, the HVAC unit **12** may include one heat exchanger or more than two heat exchangers.

The heat exchanger **30** is located within a compartment **31** that separates the heat exchanger **30** from the heat exchanger **28**. Fans **32** draw air from the environment through the heat exchanger **28**. Air may be heated and/or cooled as the air flows through the heat exchanger **28** before being released back to the environment surrounding the HVAC unit **12**. A blower assembly **34**, powered by a motor **36**, draws air through the heat exchanger **30** to heat or cool the air. The heated or cooled air may be directed to the building **10** by the ductwork **14**, which may be connected to the HVAC unit **12**. Before flowing through the heat exchanger **30**, the conditioned air flows through one or more filters **38** that may remove particulates and contaminants from the air. In certain embodiments, the filters **38** may be disposed on the air intake side of the heat exchanger **30** to prevent contaminants from contacting the heat exchanger **30**.

The HVAC unit **12** also may include other equipment for implementing the thermal cycle. Compressors **42** increase the pressure and temperature of the refrigerant before the refrigerant enters the heat exchanger **28**. The compressors **42** may be any suitable type of compressors, such as scroll compressors, rotary compressors, screw compressors, or reciprocating compressors. In some embodiments, the compressors **42** may include a pair of hermetic direct drive compressors arranged in a dual stage configuration **44**. However, in other embodiments, any number of the compressors **42** may be provided to achieve various stages of heating and/or cooling. As may be appreciated, additional equipment and devices may be included in the HVAC unit **12**, such as a solid-core filter drier, a drain pan, a disconnect switch, an economizer, pressure switches, phase monitors, and humidity sensors, among other things.

The HVAC unit **12** may receive power through a terminal block **46**. For example, a high voltage power source may be connected to the terminal block **46** to power the equipment. The operation of the HVAC unit **12** may be governed or regulated by a control board **48**. The control board **48** may include control circuitry connected to a thermostat, sensors, and alarms. One or more of these components may be referred to herein separately or collectively as the control device **16**. The control circuitry may be configured to control operation of the equipment, provide alarms, and monitor safety switches. Wiring **49** may connect the control board **48** and the terminal block **46** to the equipment of the HVAC unit **12**.

FIG. **3** illustrates a residential heating and cooling system **50**, also in accordance with present techniques. The residential heating and cooling system **50** may provide heated and cooled air to a residential structure, as well as provide outside air for ventilation and provide improved indoor air quality (IAQ) through devices such as ultraviolet lights and air filters. In the illustrated embodiment, the residential heating and cooling system **50** is a split HVAC system. In general, a residence **52** conditioned by a split HVAC system may include refrigerant conduits **54** that operatively couple the indoor unit **56** to the outdoor unit **58**. The indoor unit **56** may be positioned in a utility room, an attic, a basement, and so forth. The outdoor unit **58** is typically situated adjacent to a side of residence **52** and is covered by a shroud to protect the system components and to prevent leaves and other debris or contaminants from entering the unit. The refrigerant conduits **54** transfer refrigerant between the indoor unit **56** and the outdoor unit **58**, typically transferring primarily liquid refrigerant in one direction and primarily vaporized refrigerant in an opposite direction.

When the system shown in FIG. **3** is operating as an air conditioner, a heat exchanger **60** in the outdoor unit **58** serves as a condenser for re-condensing vaporized refrigerant flowing from the indoor unit **56** to the outdoor unit **58** via one of the refrigerant conduits **54**. In these applications, a heat exchanger **62** of the indoor unit functions as an evaporator. Specifically, the heat exchanger **62** receives liquid refrigerant, which may be expanded by an expansion device, and evaporates the refrigerant before returning it to the outdoor unit **58**.

The outdoor unit **58** draws environmental air through the heat exchanger **60** using a fan **64** and expels the air above the outdoor unit **58**. When operating as an air conditioner, the air is heated by the heat exchanger **60** within the outdoor unit **58** and exits the unit at a temperature higher than it entered. The indoor unit **56** includes a blower or fan **66** that directs air through or across the indoor heat exchanger **62**, where the air is cooled when the system is operating in air conditioning mode. Thereafter, the air is passed through ductwork **68** that directs the air to the residence **52**. The overall system operates to maintain a desired temperature as set by a system controller. When the temperature sensed inside the residence **52** is higher than the set point on the thermostat, or the set point plus a small amount, the residential heating and cooling system **50** may become operative to refrigerate additional air for circulation through the residence **52**. When the temperature reaches the set point, or the set point minus a small amount, the residential heating and cooling system **50** may stop the refrigeration cycle temporarily. The indoor unit **56** and/or the outdoor unit **58** includes a flash gas bypass system in accordance with present embodiments.

The residential heating and cooling system **50** may also operate as a heat pump. When operating as a heat pump, the roles of heat exchangers **60** and **62** are reversed. That is, the heat exchanger **60** of the outdoor unit **58** will serve as an evaporator to evaporate refrigerant and thereby cool air entering the outdoor unit **58** as the air passes over the outdoor heat exchanger **60**. The indoor heat exchanger **62** will receive a stream of air blown over it and will heat the air by condensing the refrigerant.

In some embodiments, the indoor unit **56** may include a furnace system **70**. For example, the indoor unit **56** may include the furnace system **70** when the residential heating and cooling system **50** is not configured to operate as a heat pump. The furnace system **70** may include a burner assembly and heat exchanger, among other components, inside the indoor unit **56**. Fuel is provided to the burner assembly of the furnace **70** where it is mixed with air and combusted to form combustion products. The combustion products may pass through tubes or piping in a heat exchanger, separate from heat exchanger **62**, such that air directed by the blower **66** passes over the tubes or pipes and extracts heat from the combustion products. The heated air may then be routed from the furnace system **70** to the ductwork **68** for heating the residence **52**.

FIG. **4** is an embodiment of a vapor compression system **72** that can be used in any of the systems described above. The vapor compression system **72** may circulate a refrigerant through a circuit starting with a compressor **74**. The circuit may also include a condenser **76**, an expansion valve(s) or device(s) **78**, and an evaporator **80**. The vapor compression system **72** may further include a control panel **82** that has an analog to digital (A/D) converter **84**, a microprocessor **86**, a non-volatile memory **88**, and/or an interface board **90**. The control panel **82** and its components may function to regulate operation of the vapor compression system **72** based on feedback from an operator, from sensors of the vapor compression system **72** that detect operating conditions, and so forth.

In some embodiments, the vapor compression system **72** may use one or more of a variable speed drive (VSDs) **92**, a motor **94**, the compressor **74**, the condenser **76**, the expansion valve or device **78**, and/or the evaporator **80**. The motor **94** may drive the compressor **74** and may be powered by the variable speed drive (VSD) **92**. The VSD **92** receives alternating current (AC) power having a particular fixed line voltage and fixed line frequency from an AC power source, and provides power having a variable voltage and frequency to the motor **94**. In other embodiments, the motor **94** may be powered directly from an AC or direct current (DC) power source. The motor **94** may include any type of electric motor that can be powered by a VSD or directly from an AC or DC power source, such as a switched reluctance motor, an induction motor, an electronically commutated permanent magnet motor, or another suitable motor.

The compressor **74** compresses a refrigerant vapor and delivers the vapor to the condenser **76** through a discharge passage. In some embodiments, the compressor **74** may be a centrifugal compressor. The refrigerant vapor delivered by the compressor **74** to the condenser **76** may transfer heat to a fluid passing across the condenser **76**, such as ambient or environmental air **96**. The refrigerant vapor may condense to a refrigerant liquid in the condenser **76** as a result of thermal heat transfer with the environmental air **96**. The liquid refrigerant from the condenser **76** may flow through the expansion device **78** to the evaporator **80**. In the illustrated embodiment, a flash gas bypass configuration in accordance with present embodiments is provided (as represented by the expansion device **78**) such that liquid refrigerant is delivered to the evaporator without any substantial amount of vapor refrigerant.

The liquid refrigerant delivered to the evaporator **80** may absorb heat from another air stream, such as a supply air stream **98** provided to the building **10** or the residence **52**. For example, the supply air stream **98** may include ambient or environmental air, return air from a building, or a combination of the two. The liquid refrigerant in the evaporator **80** may undergo a phase change from the liquid refrigerant to a refrigerant vapor. In this manner, the evaporator **80** may reduce the temperature of the supply air stream **98** via thermal heat transfer with the refrigerant. Thereafter, the vapor refrigerant exits the evaporator **80** and returns to the compressor **74** by a suction line to complete the cycle.

In some embodiments, the vapor compression system **72** may further include a reheat coil. In the illustrated embodiment, the reheat coil is represented as part of the evaporator **80**. The reheat coil is positioned downstream of the evaporator heat exchanger relative to the supply air stream **98** and may reheat the supply air stream **98** when the supply air stream **98** is overcooled to remove humidity from the supply air stream **98** before the supply air stream **98** is directed to the building **10** or the residence **52**. In certain embodiments, the vapor compression system **72** may include a flash gas bypass system as disclosed herein. In the illustrated embodiment of FIG. **4**, the flash gas bypass system is represented as part of the expansion device **78**.

It should be appreciated that any of the features described herein may be incorporated with the HVAC unit **12**, the residential heating and cooling system **50**, or other HVAC systems. Additionally, while the features disclosed herein are described in the context of embodiments that directly heat and cool a supply air stream provided to a building or other load, embodiments of the present disclosure may be applicable to other HVAC systems as well. For example, the features described herein may be applied to mechanical cooling systems, free cooling systems, chiller systems, or other heat pump or refrigeration applications.

As briefly discussed above, embodiments of the present disclosure are directed to a flash gas bypass system that is configured to inhibit or substantially mitigate flow of flash gas from an expansion device (e.g., the expansion device **78**) into an evaporator (e.g., the indoor heat exchanger **62**, the evaporator **80**). To provide context for the following discussion, FIG. **5** is a schematic of an embodiment of a portion of an HVAC system **100** having a flash gas bypass system **102**. The HVAC system **100** may be configured to direct a flow of conditioned air (e.g., heated air, cooled air, dehumidified air) to a thermal load, such as a space within a building, residential home, or other suitable structure. It should be appreciated that the HVAC system **100** may include embodiments or components of the HVAC unit **12** shown in FIGS. **1** and **2**, embodiments or components of the split residential heating and cooling system **50** shown in FIG. **3**, a rooftop unit (RTU), or any other suitable air handling unit or HVAC system.

In the illustrated embodiment, the HVAC system **100** includes a vapor compression system **104**, such as the vapor compression system **72**. The vapor compression system **104** includes an evaporator **106** (e.g., the indoor heat exchanger **62**, the evaporator **80**), a condenser **108** (e.g., the outdoor heat exchanger **60**, the condenser **108**), and an expansion device **110** (e.g., the expansion valve **78**, an electronic expansion valve) that are fluidly coupled to one another via conduits **112**. As such, the conduits **112**, the evaporator **106**, the condenser **108**, and the expansion device **110** may form at least a portion of a refrigerant loop **114** of the vapor compression system **104**. Generally, a compressor **116** (e.g., the compressor **74**) is fluidly coupled to the conduits **112** and configured to circulate a refrigerant along the refrigerant loop **114** in a downstream direction **118**, for example. That is, to circulate the refrigerant through the refrigerant loop **114** in the downstream direction **118**, the compressor **116** may draw the refrigerant from the evaporator **106**, force the refrigerant through the condenser **108** and the expansion device **110**, and direct the refrigerant back into the evaporator **106**.

The HVAC system **100** may include one or more indoor fans **120** configured to draw a flow of supply air **122** across the evaporator **106**. As such, the supply air **122** may release thermal energy to the refrigerant circulating through the evaporator **106** and may discharge from the evaporator **106** as a flow of conditioned air (e.g., cooled air). The indoor fans **120** may direct the conditioned air to one or more rooms, zones, or other spaces of the building **10** or of another suitable structure serviced by the HVAC system **100**. As shown in the illustrated embodiments, the evaporator **106** includes an inlet header **124**, an outlet header **126**, and a plurality of tubes **128** extending therebetween. As discussed in detail below, the evaporator **106** may include a microchannel heat exchanger, a round tube plate fin (RTPF) heat exchanger, or another suitable heat exchanger.

In some embodiments, the HVAC system **100** includes one or more outdoor fans **130** configured to draw a flow of outdoor air **132** (e.g., ambient air) across the condenser **108**. Accordingly, the outdoor air **132** may absorb thermal energy from the refrigerant flowing through the condenser **108** to cool the refrigerant and cause the refrigerant to condense within the condenser **108**. For example, refrigerant flowing through the evaporator **106** may absorb an amount of thermal energy from the supply air **122** that is sufficient to cause the refrigerant to boil. As such, the refrigerant may discharge from the evaporator **106** as a low-pressure gas and may flow toward the compressor **116**. The compressor **116** may compress the low-pressure gaseous refrigerant received from the evaporator **106** to increase a pressure of the refrigerant and discharge the refrigerant as a high-pressure gas. Accordingly, the condenser **108** may receive a flow of the high-pressure gaseous refrigerant from the compressor **116**. In some embodiments, the outdoor air **132** directed across the condenser **108** by the outdoor fans **130** may absorb an amount of thermal energy from the high-pressure gaseous refrigerant entering the condenser **108** that is sufficient to cause the refrigerant to condense within the condenser **108**. Accordingly, the condenser **108** may output a flow of high-pressure liquid refrigerant toward the expansion device **110**. In certain embodiments, the expansion device **110** may therefore receive the refrigerant from the condenser **108** in a substantially liquid state.

As discussed above, the expansion device **110** may expand (e.g., reduce a pressure of) the high-pressure liquid refrigerant received from the condenser **108** prior to directing the refrigerant toward the evaporator **106**. In some cases, expansion of refrigerant via the expansion device **110** may cause at least a portion of the liquid refrigerant received at the expansion device **110** to vaporize and discharge from the expansion device **110** in a gaseous state. Gaseous refrigerant that is discharged from the expansion device **110** during operation of the HVAC system **100** will be referred to herein as "flash gas **134**." As such, it should be understood that, during operation of the vapor compression system **104**, the expansion device **110** may discharge a two-phase mixture of refrigerant that includes a liquid component (e.g., liquid refrigerant **136**) and a gaseous component (e.g., the flash gas **134**).

The flash gas bypass system **102** includes one or more separation components **140** that are configured to receive the two-phase mixture of the liquid refrigerant **136** and the flash gas **134** and to separate substantially all of the flash gas **134** from the liquid refrigerant **136**. Specifically, as discussed in detail herein, the separation components **140** may divert substantially all of the flash gas **134** discharging from the expansion device **110** into and through a bypass line **142** (e.g., bypass conduit) of the flash gas bypass system **102** while directing the liquid refrigerant **136** toward and into the evaporator **106** (e.g., via a header conduit **144**). As such, the separation components **140** may ensure that the refrigerant received at and flowing into the evaporator **106** is in the substantially liquid state and is substantially devoid of the flash gas **134**. For clarity, as used herein, diverting "substantially all" of the flash gas **134** into the bypass line **142** may refer to diverting 94 percent, 95 percent, 96 percent, 97 percent, 98 percent or more of the flash gas **134** output by the expansion device **110** into the bypass line **142** via the flash gas bypass system **102**. Moreover, as used herein, diverting "substantially all" of the liquid refrigerant **136** to the evaporator **106** (e.g., via the header conduit **144**) may refer to diverting 94 percent, 95 percent, 96 percent, 97 percent, 98 percent or more of the liquid refrigerant **136** output by the expansion device **110** into the evaporator **106** via the flash gas bypass system **102**.

For example, the bypass line **142** may extend from the one or more separation components **140** to a component of the vapor compression system **104** that is positioned downstream of the plurality of tubes **128** (e.g., with respect to a direction of refrigerant flow through the evaporator **106**). As an example, the bypass line **142** may extend from the one or more separation components **140** to the outlet header **126** of the evaporator **106**. However, in other embodiments, the bypass line **142** may be fluidly coupled to any other suitable portion or component of the refrigerant loop **114** in lieu of the outlet header **126**. In any case, the bypass line **142** enables the flash gas **134** flowing from the expansion device **110** to bypass the evaporator **106** and flow toward the condenser **108** (e.g., in the downstream direction **118**) without flowing through the evaporator **106**. The header conduit **144** may extend from the one or more separation components **140** to the inlet header **124** of the evaporator **106** and/or may form a portion of the one or more separation components **140**. As such, the header conduit **144** may direct the liquid refrigerant **136** received from the separation components **140** toward and into the evaporator **106**.

In the illustrated embodiment, the one or more separation components **140** include an offset impact junction **150** and a filter **152**. The offset impact junction **150** and the filter **152** may form part of or all of a first separation assembly **154** of the flash gas bypass system **102**. The first separation assembly **154** may also be referred to herein as an offset type separation assembly **154**. As used herein, a "separation assembly" may be indicative of one or more components of the flash gas bypass system **102** that are configured to inhibit or substantially mitigate flow of flash gas (e.g., from the expansion device **110**) into the evaporator **106**. The offset impact junction **150** includes a first leg **156** that may extend generally along a horizontal axis **160** (e.g., with respect to a direction of gravity) and a second leg **162** (e.g., an outlet conduit) that extends generally along a vertical axis **164** (e.g., with respect to the direction of gravity). For clarity, discussions herein relating to an axis or direction extending "generally along" another reference axis or reference direction may be indicative of the axis or direction being aligned (e.g., parallel) within a threshold angle (e.g., less than 5 degrees) of the reference axis or the reference direction. Moreover, it should be understood that discussion herein relating to certain components being "vertically above" or "vertically below" other components are with respect to the direction of gravity. Moreover, discussion herein relating to certain components being "downstream" or "upstream" of other components are with respect to the direction of refrigeration flow through the compressor **116** and along the refrigerant loop **114**.

The first leg **156** may include a first end portion **166** that is fluidly coupled to the expansion device **110** and a second end portion **168** that terminates at a wall **170** of the offset impact junction **150**. The second end portion **168** includes a port that is fluidly coupled to an initial section **172** of the bypass line **142**. The initial section **172** may extend from the second end portion **168** in an upward direction **174** (e.g., a direction that extends generally opposite to the direction of gravity) and generally along the vertical axis **164**. In some embodiments, the filter **152** may be disposed within and extend along a portion of the initial section **172**, as shown in the illustrated embodiment of FIG. **5**. The second leg **162** may be fluidly coupled to the first leg **156** at an intermediate port **176** (e.g., intermediate inlet) that may be positioned between the first end portion **166** and the second end portion **168**. As used herein, a "port" may be indicative of an inlet, outlet, coupler, opening, or channel.

During operation of the HVAC system **100**, two-phase refrigerant discharging from the expansion device **110** may enter the first leg **156** and flow in the downstream direction **118** along the first leg **156** from the first end portion **166** to the second end portion **168**. Generally, gravity may cause the flash gas **134** to accumulate vertically above the liquid refrigerant **136** flowing though the first leg **156**. As such, as shown in the illustrated embodiment of FIG. **5**, substantially all of the flash gas **134** approaching the intermediate port **176** (e.g., when flowing in the downstream direction **118**) may be positioned above the liquid refrigerant **136** and, thus, flow across and over the intermediate port **176**, while the liquid refrigerant **136** may flow through the intermediate port **176** and into the second leg **162**. The second leg **162** is fluidly coupled to the header conduit **144** and/or may form a portion of the header conduit **144**. As such, the second leg **162** may direct the liquid refrigerant **136** entering the intermediate port **176** toward and into the evaporator **106**.

The flash gas **134** flowing across and over the intermediate port **176** may impinge upon the wall **170** alongside residual liquid refrigerant **136** that has not yet flown through the intermediate port **176**. The flash gas **134** may flow into the initial section **172** of the bypass line **142**, through the filter **152**, and into a remainder of the bypass line **142**. Next, the flash gas **134** may flow along the bypass line **142** and into the outlet header **126** of the evaporator **106**. In this way, the flash gas **134** may flow through the outlet header **126** and back to the compressor **116** while bypassing the plurality of tubes **128** of the evaporator **106**. As such, in accordance with the aforementioned arrangement, the first separation assembly **154** may facilitate diverting substantially all of the flash gas **134** through the bypass line **142** while directing the liquid refrigerant **136** to the evaporator **106**.

In certain embodiments, the filter **152** may include a perforated mesh **180** or other material that is configured to block or substantially mitigate droplets of liquid refrigerant **136** from passing through the filter **152** and entering a remainder of the bypass line **142**. For example, in certain embodiments, impingement of the liquid refrigerant **136** and the flash gas **134** onto the wall **170** may cause liquid refrigerant droplets to separate from a remainder of the liquid refrigerant **136** and splash (e.g., project) in the upward direction **174**. The perforated mesh **180** of the filter **152** may be sized to enable flow of the flash gas **134** through the filter **152** (e.g., in the downstream direction **118**) while substantially blocking flow of the liquid refrigerant **136** droplets through the filter **152**. As such, the liquid refrigerant **136** droplets engaging with the perforated mesh **180** may drip back into the first leg **156** and eventually flow toward and into the second leg **162** (e.g., via the intermediate port **176**). As a non-limiting example, the perforated mesh **180** may includes a plurality of openings each having a diameter between about 0.1 millimeters and 1.0 millimeters. The perforated mesh **180** may include copper or stainless steel wire mesh, copper or other metal foam, a perforated sheet of material, or another suitable filter material. In some embodiments, a portion of or all of the filter **152** includes a conical cross-sectional profile. In other embodiments, the filter **152** may include a planar, concave, or convex piece of cross-sectional profile. Still further, the filter **152** may include a polygonal and/or non-symmetrically shaped cross-sectional profile. Moreover, in certain embodiments, the filter **152** may be omitted from the first separation assembly **154**. In such embodiments, a length of the initial section **172** may be sized such that gravity substantially blocks liquid refrigerant **136** droplets from being cast along the initial section **172** (e.g., in the upward direction **174**) and into a remainder of the bypass line **142**.

In the illustrated embodiment, the flash gas bypass system **102** includes a bypass valve **182** that is disposed along the bypass line **142** and configured to regulate flow characteristics (e.g., flow rate, pressure) of the flash gas **134** through the bypass line **142**. For example, in some embodiments, a pressure differential between the first leg **156** of the offset impact junction **150** and the outlet header **126** of the evaporator **106** may bias refrigerant flow from the first leg **156** to the outlet header **126**. As such, the bypass valve **182** may be modulated (e.g., in accordance with instructions received from a controller) between a closed position and one or more open positions to regulate flow of the flash gas **134** from the first leg **156** to the outlet header **126**, for example. It should be appreciated that the bypass valve **182**, the expansion device **110**, the compressor **116**, and/or another suitable component or components of the vapor compression system **104** may be communicatively coupled to a controller (e.g., the control panel **82** of FIG. **4**) that is configured to adjust operation of any one or combination of these components in accordance with designated control algorithms and/or control protocols.

In some embodiments, the first leg **156** of the offset impact junction **150** may be positioned vertically above a separator line **184**, which may extend along an upper edge **186** of the evaporator **106** and/or along an upper-most tube of the plurality of tubes **128**, for example. The separator line **184** may be indicative of a line defining an elevation of the upper edge **186** of the evaporator **106** and/or an elevation of the upper-most tube of the plurality of tubes **128**. Positioning the first leg **156** vertically above the separator line **184** may facilitate gravity-based separation of the liquid refrigerant **136** and the flash gas **134** via the first separation assembly **154**. In other embodiments, the first leg **156** may be positioned at any other suitable elevation with respect to the evaporator **106**.

FIG. **6** is a schematic of an embodiment of the vapor compression system **104** in which the flash gas bypass system **102** includes a second separation assembly **190**, instead of the first separation assembly **154**. The second separation assembly **190** may also be referred to herein as a tank separation assembly **190**. The second separation assembly **190** includes a separation tank **192** that is fluidly coupled to the expansion device **110** via an inlet conduit **194** (e.g., a first leg) and configured to receive the two-phase mixture of the liquid refrigerant **136** and the flash gas **134** from the expansion device **110**. The second separation assembly **190** includes a first outlet conduit **196** (e.g., a second leg) that may extend from a lower portion (e.g., with respect to gravity) of the separation tank **192** and a second outlet conduit **198** that extends from an upper portion (e.g., with respect to gravity) of the separation tank **192**.

The first outlet conduit **196** may be fluidly coupled to the header conduit **144** and the second outlet conduit **198** may be fluidly coupled to and/or form a portion of the initial section **172** of the bypass line **142**. Upon entering an interior **200** of the separation tank **192**, the separation tank **192** enables the relatively dense liquid refrigerant **136** to accumulate near the lower portion of the separation tank **192** and beneath flash gas **134** (e.g., due to gravity), while enabling the relatively less dense flash gas **134** (e.g., with respect to the density of the liquid refrigerant **136**) to accumulate vertically above the liquid refrigerant **136** (e.g., near the upper portion of the separation tank **192**). The first outlet conduit **196** may drain the liquid refrigerant **136** from the lower portion of the separation tank **192** and direct the liquid refrigerant **136** toward the evaporator **106**. A pressure differential between the interior **200** of the separation tank **192** and the outlet header **126** of the evaporator **106** may force the flash gas **134** accumulating near the upper portion of the separation tank **192** to flow through the filter **152** and enter a remaining portion of the bypass line **142**. As such, the flash gas **134** may flow through the bypass line **142** and into the outlet header **126** in accordance with the techniques discussed above. In some embodiments, a lower surface **202** of the separation tank **192** may be positioned vertically above the separator line **184** to facilitate gravity-based separation of the liquid refrigerant **136** and the flash gas **134** in the separation tank **192**.

FIG. **7** is a schematic of an embodiment of the vapor compression system **104** in which the flash gas bypass system **102** includes a third separation assembly **220** having a first separation feature **222** and a second separation feature **224**. The third separation assembly **220** may also be referred to herein as an angle-run separation assembly **220**. The first separation feature **222** may include the offset impact junction **150** (see, e.g., FIG. **5**). The second separation feature may include a T-style impact junction **226**. As discussed below, the offset impact junction **150** and the T-style impact junction **226** may cooperate to facilitate separation of the flash gas **134** from the liquid refrigerant **136** in accordance with the techniques discussed herein.

In the illustrated embodiment of FIG. **7**, the first leg **156** of the offset impact junction **150** includes a first leg portion **228** that is disposed upstream of the intermediate port **176** and a second leg portion **230** that is disposed downstream of the intermediate port **176**. In some embodiments, the second leg portion **230** may extend upward (e.g., with respect to gravity) from the intermediate port **176** toward the initial section **172** at an angle **232**. As a non-limiting example, the angle **232** may be between 92 degrees and 170 degrees. Positioning the second leg portion **230** at the angle **232** relative to the first leg portion **228** may reduce a quantity of liquid refrigerant that flows along the second leg portion **230** in the downstream direction **118** and impinges against the wall **170**, as compared to embodiments of the offset impact junction **150** in which both the first leg portion **228** and the second leg portion **230** extend parallel to one another and generally along the horizontal axis **160**. In accordance with aforementioned techniques, the offset impact junction **150** may divert substantially all of the flash gas **134** toward the bypass line **142**, while diverting the liquid refrigerant **136** through the intermediate port **176** and into the second leg **162**.

The T-style impact junction **226** may include a third leg **236** that is fluidly coupled to the second leg **162** and a fourth leg **238** that is fluidly coupled to the initial section **172** and the inlet header **124** (e.g., via the header conduit **144**). In some embodiments, the third leg **236** may extend generally along the horizontal axis **160** and the fourth leg **238** may extend generally along the vertical axis **164** such that the third leg **236** and the fourth leg **238** combine to generally form a T-shape. The third leg **236** may be fluidly coupled to the fourth leg **238** via an additional intermediate port **240** (e.g., additional intermediate inlet) of the t-style impact junction **226**.

In some embodiments, bubbles **242** of flash gas **134** may be suspended in the liquid refrigerant **136** flowing along the second leg **162** (e.g., in the downstream direction **118**). That is, in some embodiments, the offset impact junction **150** may not fully separate all flash gas **134** from the liquid refrigerant **136**, such that at least a portion of the flash gas **134** enters the second leg **162** and flows toward the third leg **236**. As such, the third leg **236** may direct flow of the liquid refrigerant **136** and the bubbles **242** in the downstream direction **118** and impinge the flow of the liquid refrigerant **136** and the bubbles **242** on an additional wall **244** of the fourth leg **238**. The additional wall **244** may extend along the vertical axis **164** and, thus, be oriented generally perpendicular to a direction of the refrigerant flow along the third leg **236**. Differences in the relative densities of the bubbles **242** and the liquid refrigerant **136** may cause the bubbles **242**, upon impinging on the additional wall **244**, to flow in the upward direction **174** along the fourth leg **238**, toward and into the bypass line **142**, while the liquid refrigerant **136** may flow in a downward direction **246** (e.g., along a direction of gravity) along the fourth leg **238** toward and into the inlet header **124**. In this way, the T-style impact junction **226** may divert residual flash gas **134** that, in some cases, may be entrapped in the liquid refrigerant **136** received from the second leg **162** in the form of the bubbles **242**, toward and into the bypass line **142**.

In some embodiments, the intermediate port **176** of the offset impact junction **150** may be positioned vertically above (e.g., elevated over and offset from) the additional intermediate port **240** of T-style impact junction **226**. Further, the additional intermediate port **240** may be positioned vertically above (e.g., elevated over and offset from) the separator line **184**, which as discussed above may be indicative of a line defining an elevation of the upper edge **186** of the evaporator **106** and/or an elevation of the upper-most tube of the plurality of tubes **128**. It should be appreciated that, in certain embodiments, the first separation feature **222** or the second separation feature **224** may be replaced with the separation tank **192** (see, e.g., FIG. **6**), for example.

FIG. **8** is a schematic of an embodiment of the HVAC system **100** in which the evaporator **106** includes multiple passes **250**. In particular, the evaporator **106** includes the inlet header **124**, the plurality of tubes **128**, the outlet header **126**, an additional inlet header **252**, an additional plurality of tubes **254**, and an additional outlet header **256**. The additional plurality of tubes **254** may extend between and fluidly couple the additional inlet header **252** to the additional outlet header **256**. As discussed below, refrigerant received at the evaporator **106** may sequentially flow through the inlet header **124**, the plurality of tubes **128**, the outlet header **126**, the additional inlet header **252**, the additional plurality of tubes **254**, and the additional outlet header **256**. As such, the plurality of tubes **128** may define at least a portion of a first pass **258** (e.g., a first flow path) through the evaporator **106** and the additional plurality of tubes **254** may define at least a portion of a second pass **260** (e.g., a second flow path) through the evaporator **106**.

In the illustrated embodiment, the flash gas bypass system **102** includes both the second separation assembly **190** (see, e.g., FIG. **6**) and the third separation assembly **220** (see, e.g., FIG. **7**). The third separation assembly **220** may be fluidly coupled along the refrigerant loop **114** between the expansion device **110** and the inlet header **124**. Particularly, the fourth leg **238** may be coupled to the inlet header **124** and the bypass line **142** may be coupled to the additional outlet header **256**. The second separation assembly **190** may be fluidly coupled along the refrigerant loop **114** between the outlet header **126** and the additional inlet header **252**. The second separation assembly **190** and the third separation assembly **220** may collectively define a fourth separation assembly **262** of the flash gas bypass system **102**. As discussed in detail below, the second separation assembly **190** facilitates removing refrigerant vapors that may discharge from the outlet header **126** of the evaporator **106** during operation of the HVAC system **100**. The fourth separation assembly **262** may also be referred to herein as a distributed separation assembly **262**.

For example, in accordance with the aforementioned techniques, the third separation assembly **220** may guide a flow of the flash gas **134** from the expansion device **110** to the additional outlet header **256** (e.g., via the bypass line **142**), while guiding a flow of the liquid refrigerant **136** (e.g., substantially liquid refrigerant) to the inlet header **124** (e.g., via the header conduit **144**). As such, the inlet header **124** may direct the liquid refrigerant **136** into and along the plurality of tubes **128**. During operation of the HVAC system **100**, the liquid refrigerant **136** flowing along the plurality of tubes **128** may absorb an amount of thermal energy from the supply air **122** that is sufficient to cause at least a portion of the liquid refrigerant **136** within the plurality of tubes **128** to boil (e.g., transition from a liquid phase to a gaseous phase). Accordingly, the outlet header **126** may receive a mixture of two-phase refrigerant from the plurality of tubes **128** that includes the liquid refrigerant **136** and a gaseous refrigerant. For clarity, as used herein, refrigerant that is transitioned from the liquid phase to the gaseous phase in the plurality of tubes **128** (e.g., via absorption of thermal energy from the supply air **122**) will also be referred to as the flash gas **134**. As such, it should be understood that the flash gas **134** may include refrigerant gas that is generated via the expansion device **110**, as well as refrigerant gas that is generated within the first plurality of tubes **258**, for example.

In any case, the outlet header **126** may discharge a two-phase mixture of liquid refrigerant **136** and flash gas **134** from the first pass **258** and direct the liquid refrigerant **136** and the flash gas **134** toward the separation tank **192** of the second separation assembly **190**, for example (e.g., via a conduit **264**). The second separation assembly **190** facilitates separation of the flash gas **134** from the liquid refrigerant in accordance with the techniques discussed above.

For example, the separation tank **192** may enable the flash gas **134** to flow through the second outlet conduit **198** and into an additional initial section **272** of an additional bypass line **274**. The additional bypass line **274** may be coupled to the bypass line **142** and/or to another suitable section of the refrigerant loop **114** (e.g., to the outlet header **126**, to the compressor **116**). A pressure differential between the additional outlet header **256** and the interior **200** of the separation tank **192** may bias flow of the flash gas **134** from the separation tank **192**, into the additional bypass line **274**, and toward the additional outlet header **256**, for example. An additional bypass valve **276** (e.g., the bypass valve **182**) may be disposed along the additional bypass line **274** and operated in accordance with the aforementioned techniques (e.g., via control signals received from a controller) to regulate flow of the flash gas **134** along the additional bypass line **274** and toward the additional outlet header **256**. In this manner, the second separation assembly **190** may enable flash gas **134** received from the outlet header **126** to bypass the second pass **260** of the evaporator **106** and flow toward the compressor **116** without flowing through the second pass **260**.

Similar to the initial section **172**, the additional initial section **272** may extend from the second outlet conduit **198** in the upward direction **174** and may be sized such that gravity substantially blocks liquid refrigerant droplets from being cast along the additional initial section **272** (e.g., in the upward direction **174**) and into a remainder of the additional bypass line **274**. In some embodiments, an additional filter **278** (e.g., the filter **152**) may be disposed within and extend along a portion of the additional initial section **272**, as shown in the illustrated embodiment of FIG. **8**.

The first outlet conduit **196** of the separation tank **192** may drain the liquid refrigerant **136** from the lower portion of the separation tank **192** and direct the liquid refrigerant **136** into the additional inlet header **252**. The additional inlet header **252** may thus receive a flow of substantially liquid refrigerant from the separation tank **192** that is substantially devoid of the flash gas **134**. In this way, the second separation assembly **190** may ensure that the refrigerant received at the additional inlet header **252** is in the substantially liquid state. The additional inlet header **252** may direct the liquid refrigerant into and through the additional plurality of tubes **254**, such that the liquid refrigerant **136** may flow through the second pass **260** of the evaporator **106** and discharge into the additional outlet header **256**.

It should be appreciated that, in other embodiments, the second separation assembly **190** and/or the third separation assembly **220** may be replaced with any other suitable separation feature or combination of separation features discussed herein. As such, it should be understood that the fourth separation assembly **262** may be indicative of a separation assembly that includes any one or combination of separation features that are fluidly coupled between the expansion device **110** and the inlet header **124**, as well as any one or combination of separation features that are fluidly coupled between the outlet header **126** and the additional inlet header **252**. As a non-limiting example, the fourth separation assembly **262** may include the offset impact junction **150**, the T-style impact junction **226**, the separation tank **192**, or a combination thereof, that is disposed between the expansion device **110** and the inlet header **124**, and may include the offset impact junction **150**, the T-style impact junction **226**, the separation tank **192**, or a combination thereof, that is disposed between the outlet header **126** and the additional inlet header **252**.

FIG. **9** is a schematic of an embodiment of the HVAC system **100** in which the evaporator **106** is a round tube plate fin (RTPF) heat exchanger. In the illustrated embodiment, the evaporator **106** includes a first plurality of tubes **300** that extend between a first distributor **302** and a first collector **304**, a second plurality of tubes **306** that extend between a manifold **308** (e.g., a header, such as the inlet header **124**) and a second collector **310**, and a third plurality of tubes **312** that extend between a second distributor **314** and a third collector **316**. As discussed below, the first, second, and third plurality of tubes **300**, **306**, and **312** may sequentially define a first, second, and third pass (e.g., refrigerant flow path) through the evaporator **106**. The third collector **316** and the bypass line **142** may be fluidly coupled to the compressor **116** at a junction **318**.

In some embodiments, the expansion device **110** may be fluidly coupled to first plurality of tubes **300** via the first distributor **302** and configured to supply the two-phase mixture of liquid refrigerant **136** and flash gas **134** to the first distributor **302**. The first distributor **302** may distribute the mixture of two-phase refrigerant received from the expansion device **110** into the first plurality of tubes **300**, such that the two-phase refrigerant may absorb thermal energy from an air flow direct across the evaporator **106**, for example. The first distributor **302** may uniformly distribute any flash gas **134** that may be received from the expansion device **110** between the first plurality of tubes **300**. In this way, an overall impact of the flash gas **134** on the heat exchange efficiency of individual tubes of the first plurality of tubes **300** may be substantially negligible.

The first collector **304** may receive the two-phase refrigerant from the first plurality of tubes **300** and direct the two-phase refrigerant to a fifth separation assembly **320**. The fifth separation assembly **320** may also be referred to herein as an RTPF separation assembly **320**. The fifth separation assembly **320** may include some of or all of the components of the first separation assembly **154** (see, e.g., FIG. **5**), the second separation assembly **190** (see, e.g., FIG. **6**), and/or the third separation assembly **220** (see, e.g., FIG. **7**), and may facilitate separation of the flash gas **134** from the liquid refrigerant **136** in accordance with the aforementioned techniques. Specifically, the fifth separation assembly **320** may direct the flash gas **134** received from the first collector **304** through the filter **152**, the bypass valve **182**, and the bypass line **142**, such that the flash gas **134** may flow toward the compressor **116** without flowing through a remainder of the evaporator **106**. The fifth separation assembly **320** may guide the liquid refrigerant **136** to the manifold **308** via a conduit **322**. As such, the manifold **308** may direct the liquid refrigerant **136** into the second plurality of tubes **306** and enable the liquid refrigerant **136** to circulate through a remainder of the evaporator **106** and flow toward the compressor **116**.

It should be appreciated that, because the fifth separation assembly **320** may direct substantially liquid refrigerant toward the second plurality of tubes **306**, a distributor (e.g., the first distributor **302**, the second distributor **314**) may not be fluidly coupled between the fifth separation assembly **320** and the second plurality of tubes **306**. Further, in embodiments where a separation assembly is fluidly coupled between the expansion device **110** and the first plurality of tubes **300**, the first distributor **302** may be omitted and replaced within a manifold (e.g., a header, such as the inlet header **124**). Moreover, in embodiments where a separation assembly is fluidly coupled between the second collector **310** and the third plurality of tubes **312**, the second distributor **314** may be omitted and replaced within a manifold (e.g., a header, such as the inlet header **124**).

In some embodiments, the HVAC system **100** may not include a separation assembly fluidly coupled between the expansion device **110** and the first distributor **302** and/or between the second collector **310** and the second distributor **314**. However, in other embodiments, the HVAC system **100** may include a separation assembly fluidly coupled between the expansion device **110** and the first distributor **302** and/or between the second collector **310** and the second distributor **314**. In some embodiments, the respective separation assembly that may be positioned between the expansion device **110** and the first distributor **302** may direct substantially all flash gas **134** discharging from the expansion device **110** into the bypass line **142**, prior to the flash gas **134** flowing through the evaporator **106**. Similarly, the respective separation assembly that may be positioned between the second collector **310** and the second distributor **314** may direct substantially all flash gas **134** discharging from the second collector **310** into the bypass line **142**, prior to the flash gas **134** flowing through a remainder of the evaporator **106**.

FIG. **10** is a schematic of an embodiment of the HVAC system **100** in which the vapor compression system **104** includes a first reversing valve **330** and second reversing valve **332** that are fluidly coupled to the refrigerant loop **114** and configured to regulate flow of refrigerant through the refrigerant loop **114**. As discussed below, the evaporator **106**, also referred to herein as an indoor coil **334**, may operate as an evaporator or a condenser based on an operational mode (e.g., cooling mode, heating mode) of the HVAC system **100**. Indeed, the first and second reversing valves **330**, **332** enable the HVAC system **100** to operate in a cooling mode, in which the indoor coil **334** is configured to cool the supply air **122**, and a heating mode, in which the indoor coil **334** is configured to heat the supply air **122**. Further, the condenser **108**, also referred to herein as an outdoor coil **336**, may operate as a condenser or an evaporator based on whether the HVAC system **100** is operating in the cooling mode or the heating mode, respectively. In the illustrated embodiment of FIG. **10**, the HVAC system **100** is in the cooling mode.

In the cooling mode of the HVAC system **100**, a first valve passage **340** of the first reversing valve **330** receives a flow of refrigerant (e.g., heated refrigerant) from the compressor **116** and directs the refrigerant in the downstream direction **118** to the outdoor coil **336**. The outdoor coil **336** discharges the refrigerant and directs the refrigerant to a first valve passage **342** of the second reversing valve **332**. The second reversing valve **332** directs the refrigerant received from the outdoor coil **336** through the expansion device **110** (e.g., in the downstream direction **118**) and into a separation assembly **344**. Accordingly, the separation assembly **344** may divert flash gas **134** discharging from the expansion device **110** to the bypass line **142**, while diverting the liquid refrigerant **136** back toward the second reversing valve **332**. It should be understood that the separation assembly **344** may be indicative of a separation assembly that includes any one or combination of the aforementioned separation features that may be fluidly coupled between the expansion device **110** and the second reversing valve **332**. As a non-limiting example, the separation assembly **344** may include the offset impact junction **150**, the T-style impact junction **226**, the separation tank **192**, or a combination thereof, that is fluidly coupled between the expansion device **110** and an inlet **346** of the second reversing valve **332**.

The separation assembly **344** may guide liquid refrigerant toward a second valve passage **348** of the second reversing valve **332**, which is fluidly coupled to the indoor coil **334** and configured to direct the liquid refrigerant toward the indoor coil **334**. As such, the refrigerant flowing through the indoor coil **334** may absorb thermal energy from the supply air **122** such that the supply air **122** may discharge from the indoor coil **334** as the conditioned air (e.g., cooled air). A second valve passage **350** of the first reversing valve **330** may receive the refrigerant discharging from the indoor coil **334** and direct the refrigerant back toward the compressor **116** via a conduit **352**. As shown in the illustrated embodiment, the bypass line **142** may be fluidly coupled to the conduit **352** and, thus, enable flash gas **134** to flow from the expansion device **110** back into the compressor **116** without flowing through the indoor coil **334**.

FIG. **11** is a schematic of an embodiment of the HVAC system **100** in the heating mode. In the heating mode of the HVAC system **100**, a third valve passage **360** of the first reversing valve **330** receives a flow of refrigerant (e.g., heated refrigerant) from the compressor **116** and directs the refrigerant in the downstream direction **118** to the indoor coil **334**. As such, the supply air **122** may absorb thermal energy from the refrigerant in the indoor coil **334** and discharge from the indoor coil **334** as the conditioned air (e.g., heated air). The indoor coil **334** discharges the refrigerant and directs the refrigerant to a third valve passage **362** of the second reversing valve **332**. The second reversing valve **332** directs the refrigerant received from the indoor coil **334** through the expansion device **110** (e.g., in the downstream direction **118**) and into the separation assembly **344**. Accordingly, the separation assembly **344** may divert flash gas **134** discharging from the expansion device **110** to the bypass line **142**, while diverting the liquid refrigerant **136** back toward the second reversing valve **332**. Particularly, the separation assembly **344** may guide the liquid refrigerant toward a fourth valve passage **364** of the second reversing valve **332**, which is fluidly coupled to the outdoor coil **336** and configured to direct the liquid refrigerant toward the outdoor coil **336**. A fourth valve passage **366** of the first reversing valve **330** may receive the refrigerant discharging from the outdoor coil **336** and direct the refrigerant back toward the compressor **116** via the conduit **352**. As such, the bypass line **142** enables the flash gas **134** to flow from the expansion device **110** back into the compressor **116** without flowing through the outdoor coil **336**.

The following discussion continues with concurrent reference to FIGS. **10** and **11**. It should be appreciated that the first and second reversing valves **330**, **332** enable the compressor **116** to force refrigerant in the downstream direction **118** through the expansion device **110** and into the separation assembly **344** irrespectively of whether the HVAC system **100** is operating in the cooling mode or the heating mode. That is, the first and second reversing valves **330**, **332** may cooperate to guide refrigerant flow through the expansion device **110** and into the separation assembly **344** in the downstream direction **118** while the indoor coil **334** is operating to cool the supply air **122** (e.g., in the cooling mode of the HVAC system **100**) and while the indoor coil **334** is operating to heat the supply air **122** (e.g., in the heating mode of the HVAC system **100**). Advantageously, by directing the refrigerant through the expansion device **110** in the same direction (e.g., the downstream direction **118**) irrespectively of whether the HVAC system **100** is operating in the cooling mode or the heating mode, a single, unidirectional expansion device (e.g., the expansion device **110**) may be adequate to enable operation of the HVAC system **100** in both the cooling or heating modes. Further, by directing the refrigerant into and through the separation assembly **344** in the same direction (e.g., the downstream direction **118**) irrespectively of whether the HVAC system **100** is operating in the cooling mode or the heating mode, a single bypass line **142**, bypass valve **182**, and filter **152** may be adequate to enable the flash gas **134** to selectively bypass the indoor coil **334** or the outdoor coil **336** depending on whether the HVAC system **100** is operating in the cooling mode or the heating mode. In this manner, a quantity of components included in the vapor compression system **104** may be reduced as compared to, for example, embodiments of the vapor compression system **104** that utilize multiple expansion valves and/or a bi-direction expansion valve to enable effective operation of the vapor compression system **104** as a heat pump.

In the illustrated embodiment of FIG. **11**, the HVAC system **100** includes a controller **280** (e.g., the control panel **82**, a controller of the flash gas bypass system **102**) that may be communicatively coupled to the first reversing valve **330**, the second reversing valve **332**, the compressor **116**, the expansion device **110**, and/or another suitable component or components of the HVAC system **100** to facilitate control of the HVAC system **100** and the flash gas bypass system **102** in accordance with the techniques discussed herein. For example, the controller **280** includes a processor **282**, such as a microprocessor, which may execute software for controlling the components of the HVAC system **100** and/or the components of the reheat control system flash gas bypass system **102**. The processor **282** may include multiple microprocessors, one or more "general-purpose" microprocessors, one or more special-purpose microprocessors, and/or one or more application specific integrated circuits (ASICS), or some combination thereof. For example, the processor **282** may include one or more reduced instruction set (RISC) processors.

The controller **280** may also include a memory device **284** that may store information such as instructions, control software, look up tables, configuration data, etc. The memory device **284** may include a volatile memory, such as random access memory (RAM), and/or a nonvolatile memory, such as read-only memory (ROM). The memory device **284** may store a variety of information and may be used for various purposes. For example, the memory device **284** may store processor-executable instructions including firmware or software for the processor **282** to execute, such as instructions for controlling components of the HVAC system **100** and/or the flash gas bypass system **102**. In some embodiments, the memory device **284** is a tangible, non-transitory, machine-readable-medium that may store machine-readable instructions for the processor **282** to execute. The memory device **284** may include ROM, flash memory, a hard drive, or any other suitable optical, magnetic, or solid-state storage medium, or a combination thereof. The memory device **284** may store data, instructions, and any other suitable data.

As set forth above, embodiments of the present disclosure may provide one or more technical effects useful for inhibiting or substantially mitigating flow of flash gas from an expansion device into an evaporator. In particular, embodiments of the flash gas bypass system disclosed herein are configured to direct or otherwise divert liquid refrigerant discharging from the expansion device into the evaporator while directing or otherwise diverting the flash gas into a bypass line. In this way, the flash gas bypass system ensures that substantially all flash gas that may be generated via refrigerant flow across the expansion device bypasses the evaporator (e.g., does not flow through the evaporator) and that any refrigerant received by the evaporator (e.g., from the expansion device) is in a substantially liquid state. It should be understood that the technical effects and technical problems in the specification are examples and are not limiting. Indeed, it should be noted that the embodiments described in the specification may have other technical effects and can solve other technical problems.

While only certain features and embodiments have been illustrated and described, many modifications and changes may occur to those skilled in the art, such as variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, such as temperatures and pressures, mounting arrangements, use of materials, colors, orientations, and so forth, without materially departing from the novel teachings and advantages of the subject matter recited in the claims. The order or sequence of any process or method steps may be varied or re-sequenced according to alternative embodiments. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the disclosure. Furthermore, in an effort to provide a concise description of the exemplary embodiments, all features of an actual implementation may not have been described, such as those unrelated to the presently contemplated best mode, or those unrelated to enablement. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation specific decisions may be made. Such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure, without undue experimentation.

The techniques presented and claimed herein are referenced and applied to material objects and concrete examples of a practical nature that demonstrably improve the present technical field and, as such, are not abstract, intangible or purely theoretical. Further, if any claims appended to the end of this specification contain one or more elements designated as "means for [perform]ing [a function] . . . " or "step for [perform]ing [a function] . . . ", it is intended that such elements are to be interpreted under 35 U.S.C. 112(f). However, for any claims containing elements designated in any other manner, it is intended that such elements are not to be interpreted under 35 U.S.C. § 112(f).

The invention claimed is:

1. A flash gas bypass system for a vapor compression system, comprising:

a separation assembly comprising an inlet configured to receive a refrigerant flow from an expansion valve;

a bypass conduit coupled to a first port of the separation assembly and configured to receive a first portion of the refrigerant flow via the first port, wherein the first portion of the refrigerant flow comprises flash gas;

a second port of the separation assembly coupled to an outlet conduit in fluid communication with an evaporator of the vapor compression system, wherein the outlet conduit is configured to receive a second portion of the refrigerant flow via the second port and direct the second portion of the refrigerant flow toward the evaporator, wherein the second portion of the refrigerant flow comprises liquid refrigerant;

a first leg of the separation assembly extending from the inlet to an impact wall of the separation assembly;

a second leg of the separation assembly extending from the second port and cross-wise to the first leg, wherein the second port is positioned between the inlet and the impact wall; and

a filter disposed in an initial section of the bypass conduit and configured to redirect droplets captured by the filter from the first portion of the refrigerant flow into the second portion of the refrigerant flow.

2. The flash gas bypass system of claim **1**, wherein the first port is positioned vertically above the second port with respect to gravity, and the initial section extends from the first port in an upward direction with respect to gravity.

3. The flash gas bypass system of claim **2**,

wherein the impact wall defines at least a portion of the first port, and

the first leg comprises a first leg portion and a second leg portion, wherein the first leg portion extends from the inlet to the second port, the second leg portion extends from the second port to the impact wall, and the first leg portion and the second leg portion are configured to direct at least a portion of the refrigerant flow to impinge onto the impact wall.

4. The flash gas bypass system of claim **3**, wherein the first leg portion extends at an oblique angle relative to the second leg portion.

5. The flash gas bypass system of claim **1**, wherein the separation assembly is a first separation assembly, and the flash gas bypass system further comprises:

a second separation assembly configured to be fluidly coupled between the first separation assembly and the evaporator, wherein the second separation assembly comprises:

a third leg extending from and cross-wise to the second leg; and

a fourth leg extending from and cross-wise to the third leg, wherein the fourth leg is configured to receive the second portion of the refrigerant flow from the second leg and impinge the second portion of the refrigerant flow onto an additional impact wall of the fourth leg.

6. The flash gas bypass system of claim **5**, wherein the fourth leg comprises a third port coupled to the initial section of the bypass conduit and a fourth port in fluid communication with the evaporator, wherein the third port is positioned along the initial section at a location upstream of the filter with respect to a flow direction of the first portion of the refrigerant flow through the filter.

7. The flash gas bypass system of claim **1**, wherein at least a portion of the filter comprises a conical cross-sectional geometry.

8. The flash gas bypass system of claim **1**, comprising:

the evaporator, wherein the evaporator comprises a first pass and a second pass; and

an additional separation assembly fluidly coupled between the first pass and the second pass, wherein the first pass is configured to receive the second portion of the refrigerant flow, and wherein the additional separation assembly is configured to direct a first subset of the second portion of the refrigerant flow from the first pass into the second pass and to block entry of a second subset of the second portion of the refrigerant flow from the first pass into the second pass, wherein the first subset of the second portion comprises liquid refrigerant and the second subset of the second portion comprises additional flash gas.

9. The flash gas bypass system of claim **8**, wherein the additional separation assembly is configured to direct the additional flash gas to the bypass conduit.

10. The flash gas bypass system of claim **1**, comprising the evaporator, wherein the evaporator is an indoor coil, and wherein the flash gas bypass system comprises:

a pair of reversing valves configured to direct the refrigerant flow through the expansion valve and the separation assembly in a downstream direction while the vapor compression system operates in a cooling mode and a heating mode, to direct the refrigerant flow through indoor coil in the downstream direction while the vapor compression system operates in the cooling mode, and to direct the refrigerant flow through the indoor coil in an upstream direction, opposite the downstream direction, while the vapor compression system operates in the heating mode.

11. The flash gas bypass system of claim **1**, wherein the bypass conduit is configured to direct the first portion of the refrigerant flow into an outlet header of the evaporator.

12. A heating, ventilating, and air conditioning (HVAC) system, comprising:

a refrigerant loop comprising a heat exchanger;

a separation assembly fluidly coupled to the heat exchanger and configured to receive a flow of two-phase refrigerant from an expansion valve, wherein the two-phase refrigerant comprises liquid refrigerant and gaseous refrigerant, and wherein the separation assembly comprises:

a first port coupled to a bypass conduit defining a flow path along the refrigerant loop that is independent of the heat exchanger;

a filter configured to enable flow of the gaseous refrigerant into the bypass conduit and block flow of the liquid refrigerant into the bypass conduit; and

a second port configured to receive the liquid refrigerant and to direct flow of the liquid refrigerant into the heat exchanger; and

a set of reversing valves coupled to the refrigerant loop, wherein the set of reversing valves is configured to guide flow of the two-phase refrigerant through the expansion valve and into the separation assembly in a downstream direction while the HVAC system operates in a cooling mode to cool a flow of supply air via the heat exchanger, and to guide flow of the two-phase refrigerant through the expansion valve and into the separation assembly in the downstream direction while the HVAC system operates in a heating mode to heat the flow of supply air via the heat exchanger.

13. The HVAC system of claim **12**, wherein the filter comprises a perforated mesh configured to impede the liquid refrigerant from entering the bypass conduit.

14. The HVAC system of claim **12**, wherein the separation assembly comprises an offset impact junction.

15. The HVAC system of claim **12**, wherein the separation assembly is positioned vertically above an upper edge of the heat exchanger or an upper-most heat exchanger tube of the heat exchanger.

16. The HVAC system of claim **12**, wherein the heat exchanger is a microchannel heat exchanger.

17. A heating, ventilating, and air conditioning (HVAC) system, comprising:

an evaporator comprising one or more first tubes defining a first pass for a refrigerant flow through the evaporator and one or more second tubes defining a second pass for the refrigerant flow through the evaporator; and

a separation assembly fluidly coupled between the first pass and the second pass and configured to receive the refrigerant flow from the first pass, wherein the separation assembly comprises:

a first port configured to fluidly couple to a bypass conduit;

a filter configured to enable flow of a first portion of the refrigerant flow through the first port and to block flow of a second portion of the refrigerant flow, wherein the first portion comprises flash gas; and

a second port coupled to the second pass and configured to direct the second portion of the refrigerant flow into the second pass, wherein the second portion comprises liquid refrigerant.

18. The HVAC system of claim **17**, wherein the evaporator is a round tube plate finned (RTPF) evaporator, and wherein the HVAC system does not include a distributor fluidly coupled between the separation assembly and the second pass.

19. The HVAC system of claim **17**, comprising an additional separation assembly fluidly coupled between an expansion valve and the first pass of the evaporator.

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